JOURNAL

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THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

NOVEMBER, 1856.

CIVIL ENGINEERING.

For the Journal of the Franklin Institute.

Description of a Metallic Spring for Cars, Carriages, &c. Invented by LEVI BISSELL, of the City of New York, and patented February 20th, 1855; ante-dated August 24th, 1854.

The nature of my improvement consists in the employment of a thin metallic strap, in combination with a metallic bar, rigidly attached together at each end, and so arranged that the thrust of the car on the spring, shall tend to elongate the metallic strap; the elastic force rendered available is the tendency of the thin metallic strap to retain its length and form in opposition to tensile strain.

Plate 1. Fig. 1, is a side view of the spring attached to a car truck.

Fig. 2, is a side view of the spring detached.

Fig. 3, is a top view of the spring.

A B (Fig. 2.) is a rigid metallic bar of sufficient strength to prevent its bending. It may be made of wrought or cast iron or steel, and in ordinary passenger cars, it should be about two inches square in section. It should be long enough to extend from the journal of one axle to the journal of the next axle on the same truck as shown at A B, Fig. 1.

To the extremities of A and B of this rigid bar, a metallic strap of wrought iron, C D, is rigidly attached. This metallic strap, C D, is made of wrought iron about $\frac{3}{4}$-inch thick, (varied of course according to the degree of pressure to be resisted,) and about three inches wide.

The metallic strap C D, is attached to the extremities A and B of the rigid bar, either by hooking and rivets, as shown in Fig 2, or by welding.

M N is an upright metallic support or bracket, and is shaped as shown in Fig. 4. It is flat on top and has a pin which passes across and rests at H, upon the middle of the strap C D. This bracket is to receive the vertical pressure and transfer it to the metallic strap C D. The compound spring thus formed is attached and operates as follows: the body of the truck frame on each side rests upon the top of the brackets M N, as shown at Fig 1.

The extremities A and B, respectively rest upon the top of the boxes of two contiguous axles, as shown in Fig. 1. When the truck is attached to the car, the weight of the car presses upon the bracket M N, in the direction of the arrow, and as the extremities A and B, are supported by the journals of the axles, the metallic strap C D tends to recede from the rigid bar A B at the point H. The strap C D can only recede by increasing its length.

Instead of a single thin strap, a series of two or more straps may be used.

The principle on which my spring depends for its efficiency is the tensile elasticity of the thin metallic strap when applied in this manner.

What I claim is the combination of the rigid bar and the thin metallic strap, with their extremities rigidly attached together in the manner described.

Experiments with L. Bissell's Metallic Springs.

At the request of Mr. Levi Bissell, I attended, on Thursday, February 21st, a series of experiments upon several car springs of the forms and dimensions exhibited in the sketches hereto annexed, marked 5, 6 and 7.

Fig. 5, consisted of a central horizontal bar *e*, of wrought iron, with the upper and lower pieces, *a*, *b*, *c*, and *d*, attached together by joints at each of their extremities, as shown in the drawing.

This spring, so constructed, was placed under a testing machine and submitted to a pressure of 1000 pounds; this pressure was increased to 5000 pounds, under which weight the spring vibrated freely and retained its elasticity entirely.

Fig. 6, consisted of two pieces *f* and *g*, attached to the centre bar *e*, precisely like the centre bar *e* in Fig. 5. This form of spring was submitted to a pressure of 7800 pounds, and vibrated freely under that pressure, preserving its elasticity entirely. It vibrated about 60 times per minute with 3000 pounds, and it vibrated 48 times per minute under 5000 pounds. This size and form of spring as ordinarily used, was said by Mr. Baldwin to support 4000 pounds weight—although its elasticity did not appear to be affected by the weight of 7800 pounds. The elongation and contraction of centre bar *e*, with 7800 pounds, was between $\frac{1}{32}$d and $\frac{1}{16}$th of an inch.

Fig. 7, was of the same material, form, and dimensions as Fig. 6, except that the centre bar *e* was cut off at *xx* and *xx'*.

This form was submitted to a weight of 1000 pounds, when it vibrated slightly. Under 3000 pounds it set permanently and ceased to vibrate, and when this weight was removed the diameter *l*, *m*, (Fig. 7) had diminished $\frac{3}{4}$-of an inch from what it was at the commencement, showing a permanent change of form of spring under that pressure (3000 lbs).

Levi Bissell's Spring.

Fig. 1.

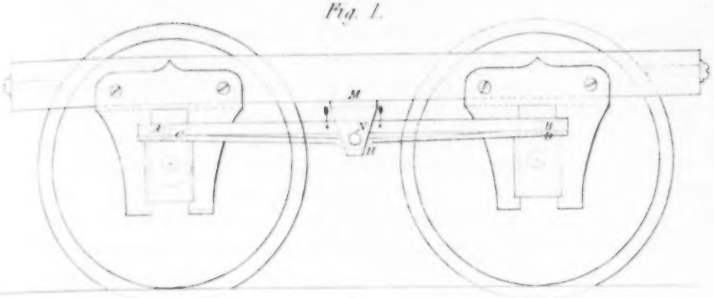


Fig. 4.

Fig. 2.

Fig. 3.

Fig. 5.

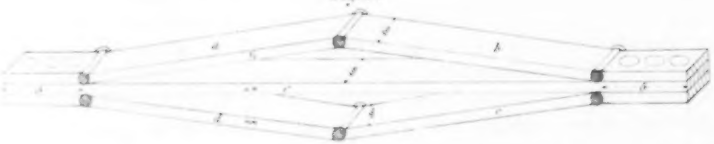


Fig. 6.

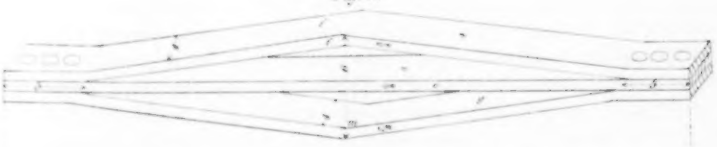
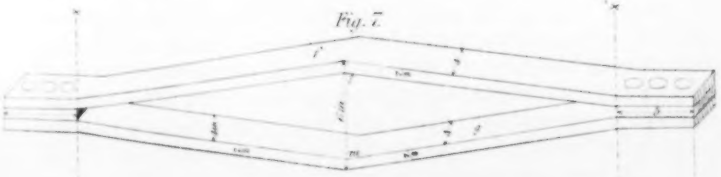


Fig. 7.



No permanent change took place in the diameter *l*, *m*, Fig. 6, under 7800 pounds, which was the amount placed on it.

Although disposed to doubt the fact at first, these experiments convinced me that the available elasticity of spring Fig. 6, is due mainly to the longitudinal elasticity of the centre bar and to the longitudinal elasticity of bars *f* and *g*, and is due only in a limited degree to the rigidity of form dependent on the arrangement of the pieces *f* and *g*.

I also saw these springs attached to a locomotive tender, at Mr. Baldwin's factory. I am under the impression that springs so constructed, render available the longitudinal elasticity of the iron, and that this is the essential feature of their action, and that they constitute a valuable improvement in the arts.

JOHN F. FRAZER.

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*Description of the Drainage of the Haarlem Mere.**

There is no land which, like the western districts of the Netherlands, called North and South Holland, has to use such means for defending itself from the sea, whose impetuous waves at many times threaten to recover the ground which, by the unremitting labor of men, has, pace by pace, been conquered by them. For a stranger not accustomed to this aspect, it must be most astonishing to see the laborer peaceably cultivating the rich soil, and the fine cattle covering the mild pastures, when he is informed that at the time of high spring-tides, with the wind blowing hard, on the giving way of the barrier defending the country from the sea, some of the lowest lands would be covered with a depth of water of no less than 7·90 met. (about 26 feet). The greatest part of these lands have, by art, been changed from stagnant pools and marshy grounds into the most precious lands, the position of which, however, necessitates a constant application of artificial means to keep them dry. An idea may be formed of the extensive drainage works performed in the two above-named districts, from the statement that since the year 1440 until the present time no less than 107,490 hectares (261,123 acres) have been converted into magnificent land. These lands requiring a good discharge for their surface water, the districts have been divided into under districts, which, though subjected to Government, have the direction of their own waterways, for their maintenance in good order, and, generally, to watch over their interest. Such an under district is called *Waterschap*, which has often a great extension. These under districits contain one or more reservoirs, natural or artificial, being their catch-water, or so-called *boezem*. These *boezems* have to fulfil different duties, one of the greatest being to collect the superfluous water during high tide, and discharge it when the level of the sea or river into which it is to be discharged has fallen enough for this purpose. Also, in very dry summers, they are to retain a sufficient quantity of soft water for the fields and pastures, and for the communication by water. The higher lands discharge their water into these *boezems* by lying on a higher level; the lower lands, which are separated from them by dykes, dis-

* From the Lond. Artizan, June, 1856.

charge their superfluous water by artificial means into these *boezems*, which communicate with the sea or adjacent rivers by sluice-gates.

The under district or *Waterschap*, in which is the late Haarlem Mere, is called *Ryhnland*, having an area of 123,500 hectares (305,185 acres), of which, before the drainage of the mere, 22,700 hectares (56,095 acres) were *boezem*, 30,740 hectares (75,962 acres) high lands, and 70,060 hectares (173,128 acres) lands which are artificially kept dry.* The accompanying map† represents this district as it is, confined on the north side by the Y, being a branch of the inland sea, called the *Zuider Zee*, on the west by the North Sea, on the south by the under districts or *Waterschappen*, *Delfland*, and *Schieland*, and on the east side by high lands.

It is enclosed, almost totally, by embankments; the defence against the North Sea, however, consisting chiefly in natural downs, though, in some points, as these were wanting, the defence had to be completed by artificial embankments, requiring an unremitting care and heavy expense. The means of discharge of *Rhynland* are confined to three points—viz: one on the Y at *Spaarndam*, by four sluice-gates, having a collective breadth of 23·96 met. (78 ft. 7½ in.), and at *Halfweg* by three sluice-gates, having a collective breadth of 17·61 met. (57 ft. 9½ in.); two on the North Sea at *Katwyk*, by a sluice-gate, with three apertures, having a collective breadth of 16·95 met. (55 ft. 7½ in.); and three on the river *Yssel* at Gouda, by three sluice-gates, measuring together 19·10 met. (62 ft. 8 in.). The *Yssel* discharges itself into the river *Maas*, which falls into the North Sea. On inspecting the map, it will be readily observed that by the situation of the points of discharge, this district has almost always the facility of discharging its surface water, for when heavy winds from the west and south-west drive the water to the coast along the North Sea, the water on the north coast, on the contrary, is driven away. When, on the contrary, the water of the Y is being sent up by heavy easterly winds it is driven from the coast of the North Sea, whereby the sluice-gates at *Katwyk* draw off the water, though the *boezem* in this case is not lowered so much in the same time as by the discharge on the Y, owing to the lesser breadth of the sluice-gates and the longer and more tortuous way by which the water has to go. The sluice-gates at Gouda discharge very little water, owing to the gradual rising of the river bed.

After these preliminary remarks, which were necessary to a proper understanding of this subject, we may proceed to describe the different works executed to drain the Haarlem Mere.

This mere, lying on the north side of *Rhynland*, had not always the great extent which it had at the time of its drainage. The earliest existing map informs us that in the year 1531 there existed no more than four little meres, that there were different roads, and three villages, which at the time of the drainage being commenced had been swept away, and the surface covered with water. These four meres, of which the position is shown on the map by dotted lines, had, perhaps, no greater surface than about 6000 hectares. In the year 1591, one of the villages had already disappeared, and the four meres had extended to a single

* Of these high lands, 11,400 hectares are sand hills or downs, being a natural barrier against the sea, so that 19,340 hectares only (47,790 acres) are cultivated.

† This map will be given in our next.—Ed.

one. In 1647 the two other villages were drowned, and the (until then not existing) *Kager Mere* on the south side was formed; the mere at that time covered an area not much less than at the time of its drainage. The mere extending itself more and more, necessitated incessant renewals of the works constructed to limit its further extension, and the construction of new ones; even so that during many consecutive years no less than from 30,000 to 40,000 florins (£2500 to £3300) had to be expended. It was now more to be feared that the mere would unite with the smaller meres adjacent to the east side, which would have been a calamity of which the consequences would have been of the most frightful character.

As early as the year 1617, a plan was formed to drain the lake, which was renewed in 1631, but without any success. In 1643 a talented millwright, named Leeghwater, having very successfully performed many operations of this nature, produced an elaborate plan for the drainage of the Haarlem Mere, to be executed by surrounding the mere by an embankment, on the outside of which is to be formed a channel for the purpose of isolating the waters of the mere from those of the surrounding country, and conveying them to the existing points of discharge. The draining was to be performed by 160 wind-mills, in four rows, each lower row bringing the water to a higher one, which again lifted it to the third row, by which it was to be raised to the fourth, discharging it finally in the channel. The enclosure was to cover an area of 17,000 hectares (42,000 acres), the probable cost being calculated at 3,690,000 florins (£307,333). This plan exhibits much ingenuity, and was the basis on which the great number of subsequent plans were formed. No less than fifteen different plans, more or less practicable, were formed in the two centuries since the first great plan of Leeghwater was published, succeeding each other at smaller intervals, according to the greater extension of the lake, until, in 1836, the heavy storms in November and December decided the fate of the lake. On the 29th of November of this year a heavy storm, blowing from the west, swept the waters under the walls of Amsterdam; while on the 25th of December, by a violent storm from the east, the waters inundated an immense tract of land on the side of Leyden, while even a portion of that city was drowned by the irresistible waves. Many of the lower lands then inundated, remained in this position during more than a year. This fixed once more the attention on the necessity of the drainage of the mere; even so that in August, 1837, by a royal decree, a commission was assigned to examine the then existing plans of drainage, and to report on it before November of the same year.

This commission had finished its task as early as the end of October, and offered its report, of which the principal points were as follow:—

The discharge of the water from the mere should take place on the *boezem* of *Rhynland*, for if the water should be discharged on the Y and the North Sea by particular channels, it would involve almost insurmountable difficulties. The *Spiering Mere* (shown on the map, on the north side of the mere) should not be drained, but reserved as catchwater, for assisting the discharge by the sluices at *Halfweg*, to which a fourth was to be added, for the wind, blowing on a great surface before

the sluice-gates, assists considerably in urging the discharge of water, which is not the case in a narrow canal, which, besides, has the disadvantage of occasioning a great difference of level at different points. One of the first points of consideration was the care for a ready discharge, which was the more necessary, as while, by draining the Haarlem Mere, the *boezem* of *Rhynland* should be reduced to about one-fourth; therefore, it was recommended by the commission to improve the sluice-gates at *Katwyk*, and to widen its canal leading to the mere. Moreover, they proposed improving and deepening the river *Spaarne* (shown on the map), and erecting a steam engine at Spaarndam of 180 H. P., with a sluice-gate for discharging its water. This engine had to raise the water on the Y at the time of high winds or high tides impeding a natural discharge. The lake had to be enclosed by an embankment, which, again, was surrounded by a canal, serving as an outfall for the waters to be raised, and, at the same time, being of such a capacity as to offer ample facilities to the navigation. This embankment was to have a length of 49 kilometers (30·44 miles); the canal to have a breadth of from 35 to 40 met. (115 to 130 ft.), and a depth of 3 met. (10 ft.). The commission proposed to drain the lake by wind-mills, with auxiliary steam power. They recommended two rows of 32 mills (actuating Archimedean screws) and three rows of five mills each (actuating inclined flash-wheels), so that the total number of mills should amount to 79. Moreover, they proposed the erection of three steam engines of 40 H. P., each (actuating Archimedean screws), to be placed each in the neighborhood of one of the points of discharge. They valued the cost at 8,355,000 florins (£400,000, nearly), besides 400,000 florins (£33,000) for unprovided works.

Many difficulties and obstacles had to be surmounted before the execution of such an enterprise was finally fixed; and it was not until the 22d of March, 1839, that a royal decree was passed, ordering the drainage of the Haarlem Mere to be executed by the Government in the manner of all public works, and that the plan of 1837 should be followed, save any alterations to be fixed afterwards.

A commission was appointed for superintending the works, composed of eleven members, of high standing in society, and of scientific attainments, being partly Members of Parliament and partly Royal Engineers. After some alterations, this commission finally consisted of thirteen members, of which Mr. D. F. Geversran Endegeest, was elected as chairman. Afterwards two Royal Engineers, Messrs. P. Kock and J. A. Bijerinck, were appointed for the execution of the works, the task being a most difficult one, but one which they have executed in the most laudable manner.

It being determined that this gigantic work should be undertaken, notwithstanding the many claims from different sides, arising from ignorance or ill will, and which are called forth by every great enterprise, the commission began its heavy task with great vigor and courage. Many alterations were made in the previous plan, and when at last the final plan was issued, it contained the following leading points:—

The drainage of the entire mere (including the *Spiering* and *Kager Meres*), covering a surface of 18,100 hectares (44,727 acres), and having a mean depth of 4 met. (about 13 ft.)

Surrounding the mere by a continued embankment, having a length of 59·5 kilomet. (37·5 miles nearly), of which a length of 2780 met. (9120 ft.) had to be formed through the water.

The formation of a large canal for the discharge of the water and the navigation, which, besides, had to receive all the water previously discharged into the mere; the formation of embankments wherever the canal happened to intersect low lands, for isolating these lands from the canal; constructing bridges over the canal for the communication with the lands to be afterwards reclaimed from the mere.

The discharging of the water to be raised by means of the above named canal on the *boezem* of *Rhynland*.

To provide by adequate means for the discharge of this *boezem*, which was considerably to be reduced by the drainage of the mere, and which, without such means, would rise to too high a level. This had to be effected—1st, by improving the outfall at *Katwyk*; 2d, by widening and deepening the river *Spaarne*; 3d, by erecting a steam engine of at least 180 H. P. at *Spaarndam* for raising the water from the *boezem* on the Y when the natural discharge should happen to be interrupted by some cause or other; 4th, by constructing a fourth sluice-gate at *Halfweg*.

Providing the means for furnishing soft water in very dry summers, it being proposed to attain the same by making a communication with the river *Yssel*.

Constructing different works for the use of the navigation, and compensating for the greater distance which ships had to go by following the intercepting canal.

Providing means for compensating the loss arising by the drainage of the mere to the system of defence of Amsterdam by inundation.

The division of the mere after the drainage; the forming of canals; construction of roads and bridges.

Such were the leading points of the plan to be followed in draining the mere, and according to which the drainage has been performed.

We will subsequently describe the different works in the order in which they have been executed.

Before anything could be done, the commission had to obtain possession of the different grounds adjacent to the mere, and necessary to the execution of the works. This has been executed without much difficulty on the part of the proprietors, who have generally transferred them for reasonable prices, the total expense having been 706,373 fl. (£58,880). Being in possession of these grounds, the first thing to be done was the providing means for a good discharge of the waters. It was resolved to begin by improving the waterway from the mere to the sluice-gates at *Katwyk*, which was very tortuous and narrow, the greatest part being a small existing stream, and a small part, nearest to the sluice-gates being made by art, but of too small a capacity. It was resolved to rectify the stream and to give it the necessary capacity, as also to enlarge the existing canal. The new canal has a length of 4235 met. (4631 yards), the breadth at the surface being 40 met. (131 ft.); breadth at bottom, 31·20 met. (102 ft.); average depth, 2·20 met. (7 ft. 2½ in.) The cost has been 33·05 fl. per running met. (£2 13s. 7·8d. per yard). Three bridges had to be constructed on this new canal, and two bridges on the

existing canal had to be lengthened in consequence of its enlargement, which took place a short time afterwards. Lastly, the three existing sluice-gates had to be augmented by two new ones, so that their total width was augmented to 23·73 met. (77 ft. 10 in.) By these works a spacious outfall for the waters on the North Sea was provided for, while, in the meanwhile, works were undertaken to insure a good discharge of the superfluous water on the Y; therefore a great number of shoals in the river *Spaarne* had to be removed, while at the same time a towing path was constructed along this river from the mere to *Spaarndam*. Before the drainage of the mere could begin, all the works for the discharge of the water had to be finished, and accordingly the steam engine at *Spaarndam* had to be erected before the total enclosure of the lake could be performed. After many considerations it was determined that this steam engine should be placed at any distance from the sluice, in the great embankment separating the river from the Y, and that a short canal should be formed for the communication of the engine with the sluice-gate. The position of the engine and the different gates is represented in the adjoining sketch (Fig. 1), which needs no explanation. The engine is double-acting, with horizontal cylinder and is condensing. The steam-cylinder has a diameter of 1·52 met. (60 in.), with a stroke of 3·04 met. (10 ft.) Four boilers, with internal flues, having a diameter of 1·65 met. (5 ft. 5 in.), and a length of 11·50 met. (37 ft. 1 in.), furnish steam to the engine, which moves five flash-wheels on each side.

These wheels, having a collective breadth of 22 met. (72 ft. 2 in.), can be moved together, or any number may be moved, according to the height to which the water has to be raised.

Experiments made with this engine have proved that the difference of level of the water being about 1 met. (3 ft. 3 in.), with only four wheels, having a collective breadth of 10 met. (32 ft. 10 in.), the volume of water raised was 843 cubic met. (29,771 cubic ft.), or 84·3 cubic met. (2977 cubic ft.) per minute for each metre in breadth of the wheels. Different circumstances and difficulties delayed the erection of this engine, which was constructed by Messrs. Dixon & Co., at Amsterdam, though it was finished long enough before the drainage of the mere was commenced. On the 26th of November, 1846, it entered on regular service, and since that time until the completion of the drainage of the lake in July, 1852, it has raised from the *boezem* of *Rhynland*, on the Y, no less than 923 million cubic met. (1207 million cubic yards) of water in about 13,000 working hours, or nearly one million cubic met. more than the three powerful engines for emptying the lake discharged on this *boezem*. This is a proof of the great boon this engine is to the district, for when the *boezem* threatens to rise to too high a level, by the combined action of the three engines, and of 261 wind-mills discharging the surface water of the surrounding country on the same *boezem*, already considerably reduced, when the Y happens to be at too high a level for natural discharge, the discharge is, nevertheless, accomplished. The gate has two sluices, measuring together 14 met. (46 ft.), and is so constructed that ready means are provided to inundate the adjacent country, in case of need, for the defence of the capital.

During the construction of these works, which regarded but the im-

provement of the discharge of the *boezem*, the works for the drainage were duly undertaken, commencing with the enclosure of the lake. The embankment and the surrounding canal had to be formed simultaneously, for the ground arising from the formation of the canal had to be used for the formation of the embankment. It was determined to follow the course of the banks, save in those places where the angles should be too great, so that at those points the embankment had to be constructed in the water.

(To be Continued.)

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*Description of an Improved Construction of Crossing.**

By Henry Woodhouse.

In the Crossings used in the permanent way of railways, an important portion of the expense of maintenance arises from the wear of the wing rails, caused by the wheels wearing a groove or recess on the upper surface of each wing rail at the part where they first strike it, when they lose the support of the main rail at the point of the crossing. The effect of this wear is to cause a drop of each wheel in passing over the crossing, producing a violent blow, and leading to more rapid destruction of the wing rails, which require to be taken up and renewed, when worn into a groove at that part; the necessity for renewal occurs frequently in a short time, in situations where a heavy traffic passes over.

The object of the improved construction of crossing, described in the present paper, is to reduce the expense of these repairs, by constructing the rails of the crossings in such a manner, that when the wing rail is worn out at the part exposed to wear, it may be reversed, and the worn part replaced by another portion of the same rail; and also by making the check rails of the same form and length as the wing rails, so that when the latter are thoroughly worn out as wing rails, they can be used as check rails—what were previously the check rails being now used as wing rails.

When the crossing has been some time in use, supposing, as is generally the case, that the traffic is mainly in one direction, one of the wing rails becomes injured by the action of the outer portion of the wheel tyres at a given point,—when it is so much worn at that part as to require replacing, it is taken up and turned end over so as to bring the lower side uppermost. The crossing can now be used again till the part most exposed is worn out: the other wing rail is then substituted for the one worn, and that rail is in its turn used twice in the same manner. Each wing rail can thus be used four times, and when it is unfit for use as a wing rail, it can be put in the place of the check rail, and the check rails can then be used four times each, in the same manner as the wing rails previously. By this plan, the crossing may be renewed eight times with the same set of rails, before it is entirely worn out. In the ordinary crossing, the wing rails cannot be interchanged with the check rails, and also, as the two ends of the wing rails are not similar, they cannot be turned end for end, and can be worn only in two places each. An

* From Newton's Lond. Journal, September, 1856.

ordinary crossing can consequently be renewed only twice with the same set of rails before it is entirely worn out. The new crossing will accordingly last four times as long as an ordinary crossing. There are now 850 sets of the improved crossing in use on the London and North-Western and other railways.

The advantages to be derived from the use of the improved crossing are, simplicity of construction, and great saving in maintenance, both as regards labor and materials; the new plan is more particularly beneficial when the double-headed rail is used, but it may be adopted with advantage for any other description of rail.

The Chairman thought that the new crossing was a useful improvement on the ordinary construction, as it reduced the expense and frequency of repairs. In answer to an inquiry as to the actual saving effected in the expense of the crossing, Mr. Woodhouse stated that the new crossing would last four times as long as those on the ordinary construction, and therefore, taking the cost of a crossing at £8, the saving by the new plan was £24 per crossing, amounting to 75 per cent. saving on the total expense. This plan was applicable to all angles of crossing from 1 in 4 to 1 in 12 (the usual limits); the only difference that was made in the rails was in the angle to which they were bent, which varied according to the angle of the crossing.

AMERICAN PATENTS.

List of American Patents which issued from September 2d, to September 30th, 1856, (inclusive,) with Exemplifications.

SEPTEMBER 2.

1. For an *Improvement in Calendar Clocks;* Edwin Allen, Glastenbury, Conn.

Claim.—"1st, The change wheel and gear wheel, or its equivalent, fitted to rotate with the month wheel, and carrying the leap year wheel, occupying such a position on the change wheel, as to represent the month, February, said change wheel receiving every month one-twelfth part of a complete rotation on its axis, independently of the month wheel, and the leap year wheel receiving every year, in addition to its revolution around the axis of the change wheel, one-fourth of a complete rotation on its own axis, the movement of the change wheel and leap year wheel being produced by any means equivalent to those described, and the said wheels combined and operating upon the lever. 2d, The internally notched ring on the driving wheel, or its equivalent, that transmits motion from the month wheel to the yearly rotating month card, combined with the lever and its locking pin, and the pin on the month wheel, the whole operating to lock the wheel, or its equivalent, and through it the month card till the time for moving the same, and then unlocking it as long as is required to effect the movement."

2. For an *Improvement in Harvesters;* Homer Adkins, Plymouth, Illinois.

Claim.—"The rake, operated by means of the crank and guide blocks."

3. For an *Improved Machine for Feeding Sheets of Paper to Printing Presses;* David Babson, Groton, Connecticut.

Claim.—"The stocks with points attached, said stocks being placed in a reciprocating r ame."

4. For an *Improvement in Cotton Seed Planters;* D. J. Beecher, Greenville, Miss.

Claim.—"The combination of the endless series of armed plates, with the slotted discharge tube."

5. For an *Improvement in Rotary Steam Engines;* P. D. M. Carmichael, Leroy, New York.

Claim.—"The rotary engine, composed of a piston with an eccentric rim, whose exterior fits at one point to the outer of the cylinder, and its interior, at a diametrically opposite point, to a central circular block, said rim working within a slotted rocker in an oscillating abutment."

6. For an *Improvement in Apparatus for Purifying Oil obtained from Mineral Coal;* Cummings Cherry, Pittsburgh, Penna.

Claim.—"The arrangement of the horizontal retorts, as combined with the copper heads of the rectifying chamber of the steam conduits to the oil boiler, and of the agitating apparatus."

7. For an *Improvement in Apparatus for Distilling Crude Oil from Mineral Coal;* Cummings Cherry, Pittsburgh, Penna.

Claim.—"Providing upright retorts, for the manufacture of oil from bituminous coal, with a closed top, and an opening at their bottom to be immersed in water."

8. For an *Improvement in the Preparation of Drying Oil from Oils Extracted from Bituminous Minerals;* Cummings Cherry, Pittsburgh, Penna.

Claim.—"Preparing the oil extracted from bituminous coal with litharge and rosin."

9. For an *Improved Apparatus for Arresting Carbon in Chimneys;* Hezekiah Chase, Lynn, Massachusetts.

Claim.—"The jet pipes, the deflector, and discharge flue, so that the water may first fall on the top of the deflector, and be discharged in a thin sheet over its edge, and around the mouth of the discharge flue, and this, whether the streams fall directly downward from the jet pipes and upon the deflector, or whether they may be first discharged upward, and next be caused to fall back and upon the top of the deflector, and so that such streams may serve not only to arrest carbonaceous matters which may escape or pass by and rise above the deflector, but to return them and cause them to be thrown into the receiver, after they have fallen with the streams upon the said deflector."

10. For an *Improved Filter;* David N. B. Coffin, Jr., Newton, Mass.

Claim.—"The method of applying the filtering diaphragm, and also, combining therewith the additional layers."

11. For an *Improved Street Sprinkler;* John F. Driggs, City of New York.

Claim.—"The peculiar arrangement of the perforated and slightly inclined pipe, in connexion with the uprights, or with equivalent brackets from the neighboring building and with the valve, the waste passage, and the water main, when arranged in such manner, that it may serve the double purpose of supporting awnings, signs, lamps, &c., and of rapidly and efficiently sprinkling the streets."

12. For an *Improved Bedstead;* Charles H. Gould, Concord, N. H.

Claim.—"The spring bed bottom, constructed essentially of the slats, pivoted at the lower ends, the bar, springs and band."

13. For an *Improvement in Ploughs;* Joseph P. Harris, Byhalia, Miss.

Claim.—"Combining with a sub-soil plough, a mould board, movable to different heights."

14. For an *Improvement in Adjustable Cut-Offs for Steam Engines;* Andrew Hartupee and J. Morrow, Assignors to themselves and J. P. Haigh, Pittsburgh, Penn.

Claim.—"The combination of the shaped lifter, slide, screw and stops, or their equivalents, constructed, arranged, and operating as an adjustable cut-off for steam engines."

15. For an *Improvement in Chargers for Shot Pouches;* John M. Hathaway, City of New York.

Claim.—"In combination with the slide of a shot charger, a locking apparatus, to prevent the accidental opening of the charger, but readily unlocked by the user. Also, the slots on the tube and the tongue button and spring on the tube, in combination, as a device for adjusting and holding said tubes."

16. For an *Improved Method of Boring and Mortising Hubs;* Henry Hayes, Quincy, Illinois.

Claim.—"1st, The adjustable frame with its attachments. 2d, The application of the rider to the carriage. 3d, The combination of the index, the lever, and the roller."

17. For an *Improvement in Ploughs;* Benaih C. Hoyt, Port Washington, Wis.

Claim.—"The adjustable rotary mould board combined with the beam and frame."

18. For an *Improved Raking Attachment for Reapers;* M. G. Hubbard, Penn Yan, New York.

Claim.—"The jointed rake bar, attached to the upright and connected with the pulley."

19. For an *Improved Machine for Testing Axes;* Warren Hunt, East Douglass, Mass.

Claim.—"The tool for testing the trueness of axes, consisting essentially of the bar and slotted gauge plate."

20. For an *Improved Fountain Ruling Pen;* Charles Ketchum, Penn Yan, New York.

Claim.—"A fountain ruling pen."

21. For an *Improvement in Spring Bedsteads;* Wm. H. Kimball and Andrew J. French, Assignors to themselves and Amos K. Noyes, Lynn, Mass.

Claim.—"Arranging and combining together and with the frame or bedstead, the springs and their connecting rods—the rocker bars, the levers, bars, straining screw rod, and crank nut."

22. For an *Improvement in Harvesting Machines;* Wm. A. Kirby, Buffalo, N. Y.

Claim.—"The combination of the main wheel, single plate, and rim. Also, hanging the seat to the plate and to the standard."

23. For an *Improved Pen and Pencil Case;* John H. Knapp, City of New York.

Claim.—"Placing the pen slide over or upon the tube which encloses the slotted tubes, the above parts being arranged, so that the pencil slide is shoved out at one end of the case, and the pen slide at the opposite end, and the working parts rendered so compact, that an extremely portable and extensive case is obtained."

24. For an *Improvement in Churns;* Loomis Lamb, Berlin, Conn.

Claim.—"Applying the auxiliary dasher to the shaft of the rotary dasher without any other shaft, so that the shaft of the rotary dasher may revolve in the hub of the auxiliary dasher—in combination with applying to the inside surface of the tub, a stop or projection, or equivalent means, and by which the auxiliary dasher may be stopped from revolving with the other dasher, when both are placed in the cistern, and the churn is in operation."

25. For an *Improvement in Ale and Beer Coolers;* James Mackintire, Somerville, Massachusetts.

Claim.—"The combination of the passages and gate, with the ale and water chambers, pipes, and zig-zag passages."

26. For an *Improvement in Condensers for Steam Engines;* David Mathew, Philadelphia, Pennsylvania.

Claim.—"The combination of the flat vertical tubes, connected by horizontal tubes, with rose pipes inside, and surrounded by the outer case, to condense by the combined action of air and water."

27. For an *Improved Process for Stiffening Hat Bodies;* James McCracken, Brooklyn, New York.

Claim.—"The process of stiffening wool hat bodies, by acidulating the hat bodies before applying the stiffening as a means of graduating and controlling the quantity and depth, to which the stiffener can penetrate the body of the felt, in combination with a pearl-ash solution of shellac, for stiffening the 'tip' or 'crown,' and a pearl-ash and sal-soda, combined solution of shellac for stiffening the 'brim.'"

28. For an *Improvement in the Manufacture of Black Bottle Glass;* John F. McCully, Gonzales, Texas.

Claim.—"The introduction of the clay slate as one of the ingredients in compounding the usual batch for the manufacture of black glass."

29. For an *Improved Buckle for Wearing Apparel;* Edward Parker, Plymouth, Conn.

Claim.—"Swaging or cutting the blank, or the bow and loop, entire or in one piece from a metal plate, and securing the tongue in the buckle by bending or closing the cross piece around the shank."

30. For an *Improvement in Rotary Steam Engines;* John Robingson, New Brighton, Pennsylvania.

Claim.—"The arrangement of the piston, projecting radially into, within, or through the hollow head, and forming inlet and outlet cavities or passages, on either side of it, across its whole breadth or face."

31. For an *Improved Candle Moulding Machine;* John Robingson, New Brighton, Pennsylvania.

Claim.—"Attaching a series of moulds to endless chains which have an intermittent movement, the moulds being formed of two parts, and opened and closed at the proper time by the jaws. Also, drawing the candles from the moulds by means of the jaws attached to the rod. Also, in connexion with the jaws, the plate, operating as shown, for the purpose of turning or conveying the candles in the receptacle."

32. For an *Improvement in Hay Rakes;* Hankles Heaberlin, Scipio, Indiana.

Claim.—"The combination of the revolving rake with the adjustable spring bow, so that said rake may be set to trip, and be tripped with such variable motion of the foot as may be desired."

33. For an *Improvement in Harvesting Machines;* Joel Y. Schelly, Hareford, and James Stauffer, Hosensack, Pennsylvania, Assignors to William Watson, St. Pauls, Minesota.

Claim.—"The combination of the driving wheel, supporting wheel, caster wheel, hinged tongue, and the main frame, when the said parts are arranged and operate in relation to each other."

34. For an *Improved Whiffle-tree for Detaching Horses from Carriages;* N. N. Selby, Fairview, Pennsylvania.

Claim.—"The application of the spring the whole length of the whiffle-tree, and turned over at each end, forming loops for the harness tugs, in combination with the bolt pins and fulcrum, operated by the lever."

35. For an *Improved Buckle for Wearing Apparel;* William Slade, Gum Creek, Ga.

Claim.—"The double jointed buckle."

36. For an *Improvement in Grain and Grass Harvesters;* Oren Stoddard, Busti, New York.

Claim.—"The cutters, pivoted to the finger bar, and operated by the cams on the shaft, when said cams are placed in varying positions."

37. For *Improved Invalid Chairs;* C. L. Taillant, City of New York.

Claim.—"The combination of the chair and adjustable drop or extension back, with the rack and adjusting or supporting rod."

38. For an *Improvement in Straw Cutters;* Shelton M. Thompson, Barren County, Kentucky.

Claim.—"The arrangement of the fixed knives, the revolving knives, the shaft, and spring, whereby the revolving cutters are held as rigidly parallel to the fixed cutter as if they were unyielding, and are as free to yield for the passage of obstacles, as those cutters which yield independently of the arms and shaft by which they are carried."

39. For an *Improved Self-Waiting Table;* Abdelah Watson, Falmouth, Kentucky.

Claim.—"The waiters, wire tracks, and driving cord."

40. For an *Improvement in Curtain Fixtures;* Ferdinand Wieterich and Conrad Hagan, City of New York.

Claim.—"Supporting one end of the shaft in a movable slide connected with the lever, which latter is made to act upon the cam."

41. For an *Improved Cutting Device for Harvesters;* C. Wheeler, Jr., Poplar Ridge, New York.

Claim.—"Attaching the fingers to the finger bar, and the caps to the fingers, and having a plate placed on each finger, on which plates the teeth of the sickle rest and work."

42. For an *Improved Method for Boring Hubs for Boxes;* Samuel H. Yocum, Shelbyville, Indiana.

Claim.—"Operating the bitts by the adjustable feed rods and lever with the mechanism, or its equivalent, in combination with the eight anti-friction wheels, temper screws, that confine the hub and expose a true circle to the bitts at any desired distance from the centre of the hub."

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43. For an *Improved Saw Set;* Wyllys Avery, Salisbury Centre, New York.

Claim.—"A traversing punch, arranged so that it can be vibrated or turned to suit the form or position of the saw teeth. Also, the adjustable stationary pin, so arranged as to bring the teeth of the saw into a proper position under the setting punch, when the scores between the teeth of the saw are faced on to said pin. Also, two separate frames, one hung each side of the anvil and setting punch, so arranged that when one is turned back out of the way of the handle, the other will support and sustain the saw. Also, the revolving blocks for adjusting the above mentioned frames, which support the saw during the process of setting."

44. For an *Improvement in Dress of Metallic Hemispherical Grinding Mill;* Anson Atwood, Troy, New York.

Claim.—"The series of radial ogee ribs and furrows, in combination with the intermediate or interposing ribs and furrows, cracking teeth, and hemispherical formed grinding surface."

45. For an *Improvement in Ladies' Riding Saddles;* Henry Adams, City of New York.

Claim.—"1st, The arranging of the near side horn, with the leaping horn attached directly to it, on the side of the tree or saddle, near the front and a short distance below the head of the same. 2d, Having the leaping horn attached loosely to the near side horn, so as to be capable of being reversed, and thus made to serve as a support or rest for the left leg while riding at a slow gait."

46. For an *Improvement in Breech Loading Ordnance;* G. W. Bishop, Brooklyn, New York.

Claim.—"The combination of the groove made around the seat of the breech pin, and the segments attached to the breech pin, the said segments being operated by a screw and toggle movement, or other equivalent means of spreading or expanding them into the said groove, or withdrawing them therefrom."

47. For an *Improved Machine for Manufacturing the Wooden Part of Brushes;* Thomas Mitchell, Lansingburgh, New York.

Claim.—"The combination of a circular saw with a cutting apparatus, for the purpose of applying circular saws to the cutting of the curved figures. Also, the combination of the apparatus, with a crown saw attached to an arbor, common to both, forming a tool for the advantageous manufacture of brush handles or other analogous work."

48. For an *Improved Process of Manufacturing Delaines;* John Marland, West Bridgewater, Massachusetts.

Claim.—"The method of operating upon wool by combing and subsequently carding."

49. For an *Improvement in Hanging Ships' Rudders;* Christopher N. Nixon, Ramsgate, England; patented in England May 12, 1854.

Claim.—"The use or construction as applied to sailing vessels for steering purposes of the groove or socket, whether the same be formed to extend from the top or near the top, to or near to the bottom of the stern post, whether the same be continuous or divided into sections or parts. Also, the rod, continuous or in sections, attached to the rudder, and combined with the groove, or other equivalent, attached to the stern post."

50. For an *Improvement in Cutting and Drawing Wires;* F. Noette, Brooklyn, New York.

Claim.—"1st, Feeding the circular plate to the circular cutters, and gauging the same by means of the rack shaft, with pinions attached, the pawl and ratchet, weighted lever, or equivalent, and gauge roller, arranged. 2d, Operating the reel or drum, or

giving it a vertical vibratory movement by means of the right and left screw rods, with pinions attached, and made to gear alternately into the pinion on the shaft by means of the block, lever, bar and weighted lever. 3d, The reel or drum, when constructed as shown, so that it may be compressed or contracted to allow of the ready removal of the wire from its periphery."

51. For an *Improvement in Casting Artificial Tooth Plates by the Electrotype Process;* John L. Newell, Binghampton.

Claim.—"Constructing the linings in one piece, and simultaneously with the plate, by the electrotype process. Also, filling the interstices of artificial teeth, when attached to a metallic plate, with a metallic precipitate solidified."

52. For an *Improvement in Cartridges;* Julius Riedel, Pleasant Hill, Kentucky.

Claim.—"Making the pointed ball cartridge. 1st, The shape of the cartridge is such that one end is naturally loaded heavier than the other, as represented in the section, thereby causing that end to go forward, thus guarding against all revolving motion except a simple winding or peristaltic one. 2d, The constructing the hemispherical end of the cartridge stronger and heavier than the conical end, having several objects in view, viz: that the loading of shot or balls on the inside may be kept together a considerable distance after leaving the gun, that the lighter conical end may serve to keep the whole in the given direction till the cartridge is burst, and when burst on or near its base, give free egress to its contents."

53. For an *Improved Lock;* Henry D. Russell, Naugatuck, Connecticut.

Claim.—"Liberating the knob and its stem from all connexion with the main bolt in freeing the crescent plate, by the movement of the smaller bolt, produced by the cross bar, or its equivalent, operated by the key of the door."

54. For an *Improved Wind-Mill;* John R. St. John, Lockport, New York.

Claim.—"1st, The traverse table and tail-piece for carrying the reduced part of the main shaft, and for sustaining the main shaft horizontally on the screw pivot, with the arrangement thereon of the rudder vane for its perpendicular movement. 2d, The main shaft with its hinder portion reduced, with the circular cogged rack, the collar, and the spiral spring, working therewith. 3d, The rudder vane, as performing the two offices of keeping the sails to the wind, by moving the traverse table horizontally, also as carrying the rod, and the governor vane or globe for giving a vertical movement."

55. For an *Improved Machine for Sweeping Streets;* Robert A. Smith, Brooklyn, New York.

Claim.—"1st, Placing the main broom cylinder under the axle of the traveling wheels. 2d, The curved guides of broom cylinder axle, concentric with the driving pulley, for keeping the driving band tight in all positions of the said cylinder. 3d, Hanging the conveyor on its driving shaft, with its lower extremity resting on wheels running on the surface of the ground. 4th, The arrangement of screw, box, and guides with the shaft of the gutter brush, for regulating the inclination, and preventing the oscillation of the said brush. 5th, The combination of the cylinder brush and gutter brush with the elevators."

56. For an *Improvement in Washing Machines;* Riley Smith, Towanda, Penna.

Claim.—"Connecting the hand and lever rubbers by a pivoted brace, which serves the double purpose of a guide in operating the lever rubber, and a brace for raising up and holding in a convenient position the hand rubber."

57. For an *Improvement in Apple Parers;* John D. Brown, Cincinnati, Ohio.

Claim.—"The returning or reversing action."

58. For an *Improvement in Washing Machines;* Israel F. Brown, Columbus, Ga.

Claim.—"The slatted cylinder, having a diagonal or oblique corrugated board at each end, the cylinder being partially immersed within the box."

59. For an *Improvement in Steam Engines;* William A. Clark, St. Louis, Missouri.

Claim.—"The arrangement of two or more pistons on the one piston rod, within the one cylinder, divided into compartments, the movement of each piston being limited to its respective compartment, and all the pistons traveling in the same direction."

60. For an *Improved Extinguisher for Fluid Lamps;* Wm. B. Carpenter, Brooklyn, New York.

Claim.—"The divided cap or extinguisher, in combination with the springs, and the ring."

61. For an *Improvement in Repairing Railway Bars;* Joseph D. Cawood, Marshall, Michigan.

Claim.—"The movable press block, having its edge formed to the side of the rail, in combination with another block, with its edge of a similar but reversed form (the movable block to be operated by two cams, or in any other convenient manner), for the purpose of pressing between them a T, or otherwise shaped rail, thereby facilitating the difficult operation of welding or renewing the ends of such rails, after they have been damaged."

62. For an *Improvement in Artificial Fuel;* Robert Courtney, Albany, New York.

Claim.—"The rendering coal dust or screenings into a merchantable article of artificial fuel, by combining coal dust with clay, lime, and coal tar, or other bituminous or resinous material, and subjecting them to all the parts of the process."

63. For an *Improved Method of Feeding Sawing Mills;* Calvin and George S. Dilkes, Allowaystown, New Jersey.

Claim.—"Giving motion to the pawls which actuate the feed wheel, by means of the cord and pulley or short cylinder and its stud, in combination with the slotted lever, arm, and its plate."

64. For an *Improvement in Lubricating Throstle Spindles;* George H. Daugherty, Crozerville, and Thomas G. McLaughlin, Philadelphia, Pennsylvania.

Claim.—"The lubricator of throstle spindles."

65. For an *Improvement in Seed Planters;* John Fordyce, Morgantown, Virginia.

Claim.—"In combination with the hopper and its adjustable openings, the hinge board and its blocks and figures, for regulating the discharge of the grain from said hopper, and ensuring regular feeding."

66. For an *Improved Mode of Attaching Horses to Vehicles;* George H. Gray, Clinton Mississippi.

Claim.—"The plates attached to the harness, and the plates on the shafts with loops or clasps attached to the levers, with the pins on them and the dogs, levers, and rods."

67. For an *Improvement in Links of Horse Powers;* Albert W. Gray, Middletown, Vermont.

Claim.—"Constructing the links composing the endless chain of corrugated sheet metal, so that the corrugations shall serve both as hinges for connecting the links, and as cogs for gearing with the cog-wheel on the driving shaft."

68. For an *Improvement in Pans for Evaporating Sugar;* Samuel H. Gilman, New Orleans, Louisiana.

Claim.—"An evaporator formed by the combination of a train of open boilers, the boiler x to receive the first, and the boiler q to receive the last fire; and each of the boilers in succession presenting an extent to the fire in the inverse ratio of the intensity of the fire, as well as of its (the boiler's) cubic capacity. Also, the construction and use of a flue, formed by a series of open boilers, and being in a series of sections of its length, divided longitudinally and vertically by water legs or strata of juice into two or more flues or spaces, the number of flues increasing from one section to the next, as the distance from the furnace increases, and the number of sections into which it is so divided corresponding to the number of holes in the series, and each section being shorter than the boiler in which it is placed, so as to leave a space between each section, where the flue is undivided in its transverse section."

69. For an *Improvement in Hand Corn Planters;* Heman B. Hammon, Bristolville, Ohio.

Claim.—"The employment of hexagonal or many sided revolving wheel, having offsets applied in connexion with the plunger and seed tube."

70. For an *Improvement in Reversing Gears;* George Juengst, City of New York.

Claim.—"The arrangement of the disks, the screw pivots, and the springs, or their

reversal equivalents, whereby the action of the nipping pawl is reversed, and the motion communicated by it, changed in direction, without any change of direction or cessation of motion in the moving power."

71. For an *Improvement in Metallic Car Springs;* Danforth Johnson, Chicago, Ill.

Claim.—"The combination and arrangement of a number of springs radiating from a central stud, and secured at the circumference or rim to a box or bed plate. Also, the arrangement of the convex bed plate, over which the springs bend, in combination with the stud or pillar to resist the lateral motion of the car or carriage."

72. For an *Improvement in Collision Apparatus for Railroad Cars;* John Kulinski, Charleston, South Carolina.

Claim.—"Protecting rail road trains againts the injurious effects of collision, by the attachment to their front and rear, of a series, kept at a distance from each other by elastic and rigid resistances, in such a way that a collision taking place, said shields are to fall back successively upon each other from the fore to rearmost, the resistances to yield to the shock, alternately, and in succession, by the operation of tubes and snap locks, or their equivalents.

73. For an *Improved Screw Cutter;* James W. Lyon, Brooklyn, New York.

Claim.—"The use of the slide rest, slide cutter tool, wire holder box, and spring clamp dies, or their equivalents."

74. For an *Improved Grain and Grass Harvester;* William P. Maxsom, Albion, Wis.

Claim.—"The wheel attached to the driving wheel, in combination with the curved sliding lever (on which the driving wheel is hung), and straight lever."

75. For an *Improved Mode of Suspending by Hydraulic Puppet Valves;* George Trott, R. H. Cole, and Wm. A. Clark, St. Louis, Missouri.

Claim.—"The combination of the ball, loose socket, and anti-friction washer, when employed to connect an elastic or yielding valve with its stem."

76. For an *Improvement in Marble Sawing Machines;* Jose Toll, Locust Grove, Ohio.

Claim.—"The particular combination and arrangement of the fender bars, with the adjustable guide pieces, when the same are constructed and arranged to operate in relation to each other."

77. For an *Improved Wind-Mill;* Ephraim Whitman, Abington, Massachusetts.

Claim.—"The combination and arrangement of the rotary wind flume, the series of turning blinds or gates, and the wind wheel. Also, in combination with the wind flume and its wheel, the series of guide plates, and the concentric tubular tapering case. Also, arranging the transferring shaft in the turning axis of the wind flume, and so as to pass through the lower journal thereof, and thereby enable the wind flume and driving shaft, and its beveled gear, to revolve around such transferring shaft and the beveled gear thereof, and transmit power through the shaft, under any position of the rotary flume."

78. For an *Improvement in Machinery for Forming Hat Bodies;* D. G. Wells, City of New York.

Claim.—"1st, The mode of guiding the current of air from the picking cylinder in their passage to the cone. 2d, The mode of regulating the secondary currents of air by means of the wedge-shaped apertures, formed by the valves."

79. For an *Improved Method of Drawing from Manufacturing Enclosures, Waste Gases, Steam, &c.;* Robert F. Brower, Assignor to Samuel A. and J. L. Brower, Bloomfield, New Jersey.

Claim.—"The operation of drawing off waste steam or gases by mechanism or heated currents, from buildings or apartments, where drying, steaming, or chemical operations are conducted."

80. For an *Improvement in Jacquard Looms;* James C. Cooke, Assignor to Hotchkiss & Merriman, Manufacturing Co., Waterbury, Connecticut.

Claim.—"1st, The combination of the lifting bar, with the sliding hook and rocking piece, for operating the needle. 2d, The use of a pattern cylinder, having a reciprocating, horizontal, and vertical movement combined with the movement of rotation on its axis."

81. For an *Improved Saw Gummer;* L. A. Dole, Assignor to Dole, Silver & Felsh, Salem, Ohio.

Claim.—"Arranging the cam or moving crank below the die, either in or below the die block, so as to draw down the punch or male die block. Also, the cam lever, with a movable fulcrum, in combination with the opening, so constructed and arranged as to traverse the bar with a positive motion in each direction, as the lever is vibrated."

82. For an *Improved Shingling Bracket;* Lewis A. Goodsell, Assignor to self and Daniel H. Hott, Southington, Connecticut.

Claim.—"A combination of the foot or feet, the claw or pin pointed base, and the hinged braces made fast and adjustable to each other by the catches, and dove-tail tongue receiving wedge."

83. For an *Improvement in Harvesters;* Wm. H. Seymour and Henry Pease, Assignors to Wm. H. Seymour and Dayton L. Morgan, Brockport, New York.

Claim.—"In combination with the main wheel and removable wheel, a frame capable of allowing the shifting of the former, and the removing or replacing of the latter, when the machine of the latter is to be converted from a reaper to a mower, or vice versa."

84 For an *Improvement in Harvesters;* Wm. H. Seymour and Henry Pease, Assignors to Wm. H. Seymour and Dayton S. Morgan, Brockport, New York.

Claim.—"The particular arrangement of the clutch and clutch lever, with regard to the conductor's seat and platform, and the shaft, from which motion is communicated to both the rake and sickle, as that the operator from his seat, having a distinct view of the platform, can engage or disengage said rake with his foot, whilst the sickel continues to run. Also, the combination of the universal joint for connecting the shafts, the sleeve and plate, with its guide and gimbal joint for giving the rake its traverse movement. Also, the bow and rake-head, so formed as to incline towards their outer ends, and so acting as to cause the bent or entangled straws to slide off into the platform."

85. For an *Improved Faucet;* Joseph Goodridge, Assignor to the Boston Faucet Company, Boston, Massachusetts.

Claim.—"Arranging between the caoutchouc spring, and the screw cap of the neck of the back faucet, a metallic annulus or guard ring, in order to prevent the adhesion of the cap to the india rubber spring, not meaning to claim a metallic washer as ordinarily used, but the specific application of a metallic ring to prevent a difficulty incident to the peculiar relations of parts. Also, the arrangement of the annular groove in the stem of the valve, and with reference to the sides of the spring or valve chamber, in manner and for the purpose, or so as to produce the new and useful result as specified, the said groove being intended to receive the foot of the spring made tapering, or frusto conical, in manner and for the purpose of preventing it from being caused to adhere to the sides of the said chamber by oxidation of the metal."

86. For an *Improvement in Furnace Smoothing Irons;* John Taggart, Roxbury, Assignor to self and Vernon Brown, Boston, Massachusetts.

Claim.—"Arranging the bellows between the handle and furnace or body of the flat-iron, and connecting said bellows to both, so that the said handle may be used to operate either the bellows or the flat-iron, as circumstances may require. Also, making the bellows tube or conductor in two separate pieces, and attaching them respectively to the cover and body of the furnace, so as to operate together when the cover is down, and to be separated when the cover is raised."

87. For an *Improved Mode of Adjusting Carriage Tops;* Cyrus W. Saladee, Columbus, Ohio.

Claim.—"The lateral rod, in combination with the 'top-props.' Also, the perpendicular rods, in combination with the lateral rod, and the back of the seat, for the purpose of throwing back or raising up the top while seated in the carriage."

88. For an *Improvement in Sewing Machines;* Charles R. Gardiner, Detroit, Mich.

Claim.—"1st, The sharp pointed needle, having a flexible beard for sewing in woven, felted, or other close fabrics. 2d, The adjustable slide, so arranged as to close the beard of any sized needle that may be used in the machine. 3d, The guide, consisting of the 'thread channel' and the needle passage, with the side thereof either slightly inclined or provided at the top with the inclined groove, and so operating the feed-motion given to the cloth, that it shall carry the thread in proper position that it

shall be caught by the hook or beard of the needle. 4th, The folding plate, or its mechanical equivalent. 5th, Sewing with a machine through one fold or corrugation of the material at a time; the cloth being fed along at right angles, or nearly so, to the line of the fold."

89. For an *Improvement in Lamps for Burning Fluids;* Salmon Bidewell, Rochester, New York.

Claim.—"The mode of compressing the wick, so as to prevent any change in the light caused by the jar of the lamp, and to prevent the escape of the burning fluid faster than is designed to secure the gas generated from the same, and to enable the use of any desirable fluid for lamp purposes."

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90. For an *Improved Chimney Cap;* William Brownell, Newport, Rhode Island.

Claim.—"The construction and arrangement of the ventilator."

91. For an *Improved Machine for Dressing Felloes;* William M. Bullock, Marcy, Indiana.

Claim.—"The rotating ring or band placed within the stationary ring or band, the ring or band having the cutter head shaft fitted to it, the shaft being rotated by the gearing."

92 For an *Improved Feed Motion for Shingle Machines;* John Broughton, Chicago, Illinois.

Claim.—"The disk wheel, with knives, face guide, and face cam, attached and used in connexion with the vibrating bed."

93. For an *Improvement in Heading Bolts;* Ebenezer and Philemon Ccleman, Philadelphia, Pennsylvania.

Claim.—"The levers with rollers attached to them, and the ratchet roller attached to the pendant plate. Also, the heading and jaws provided with dies, so as to operate conjointly with the rollers."

94. For an *Improvement in Dentists' Forceps;* John G. Coates, Big Lick, Virginia.

Claim—"Constructing forceps with rotating beaks to adapt themselves to the exterior formation of the tooth."

95. For an *Improved Saw-set;* Abraham Casey, City of New York.

Claim.—"The combination and arrangement of the stock having a transverse kerf, level bolster, and punch. 2d, Arranging the bolster on a turning screw pin, which moves in a slot and has a clamping nut."

96. For an *Improvement in Reefing Ships' Sails upon Extra Yards;* Joseph S. Foster, Buffalo, New York.

Claim.—"The double yard or extra yard of two pieces, placed about midway between the upper and lower yards, the sail passing between the two pieces."

97. For an *Improvement in Fire Arms;* Edmund H. Graham, Manchester, N. H.

Claim.—"1st, Arranging the chambers in which the powder is placed, and the chambers in which the balls are placed, at right angles to each other, or nearly so, and so as to communicate with each other. 2d, Covering each powder chamber at the time of the discharge, with a protecting cap or plate."

98. For an *Improvement in Harvesters;* William Gage, Buffalo, New York.

Claim.—"Raising and lowering the finger bar and cutters, by means of swinging the outside frame, to which the finger bar is attached, upon two pivots upon the inside frame, and holding the same where placed, by means of serrated plates and tightening rod, when said frames are constructed and arranged to operate in relation to each other, and the driving wheel, finger bars, and cutters. Also, the peculiarly adjustable mould board, in combination with the wheel and its supporting arm when used in mowing, for the purpose of protecting the wheel and arm from loose grass, and prevent its lodgement thereon."

99. For an *Improvement in the Preparation of Hides for Tanning;* George W. Hatch, Princeton, Illinois.

Claim.—"The use of smoke from wood or other equivalent combustibles, in the preparation of hides for rapid tanning."

100. For an *Improved Mode of Attaching Shafts to Sleighs;* George Kenney, Milford, New Hampshire.

Claim.—"Attaching the shafts to the runners of the sleigh by means of the eyes and rods, said eyes and rods being attached to the cross pieces provided with springs."

101. For an *Improvement in Granulating Metals;* John Feix, San Francisco, Cal.

Claim.—"The use of the outer and inner vessels, in connexion with the pipe and its elbows, for keeping the water in circulation, and for granulating the metals."

102. For an *Improved Machine for Cutting Paper,* Hervey Law, City of New York.

Claim.—"The combination of the rising and falling platform, and clamping frame, by means of toggles, said toggles having cranks connected with them, the pintles of which work in curved grooves, or otherwise actuated."

103. For an *Improved Carpenter's Bench;* J. W. Mahan, Lexington, Illinois.

Claim.—"The carpenter's and cabinet-maker's assistant bench."

104. For an *Improved Printing Press;* A. B. Newbury, Windham Centre, N. York.

Claim.—"1st, The rotating and reciprocating printing cylinder, operated by means of the endless racks, pitman, and bars. 2d, The revolving fly."

105. For an *Improvement in Churns;* Albert Pease, Weston, Vermont.

Claim.—"The combination of the two fixed boards on the dasher handle, and a sliding board or its equivalent moving between them."

106. For an *Improvement in Locomotive and Steam Boiler Furnace;* William P. Parrott, Boston, Massachusetts.

Claim.—"The hollow box or cone, having tubes for the passage of the smoke and gas, and apertures for the admission of heated air, so arranged as intimately to mix the two."

107. For an *Improved Clevis;* Edwin A. Palmer, Clayville, New York.

Claim.—"The pin provided with a spring and arms, in combination with the projection in the head and openings through which the arms may pass."

108. For an *Improvement in Variable Cut-offs for Steam Engines;* Charles H. Reynolds, Lewiston, Maine.

Claim.—"The arrangement of the suspended lifting rods with their studs secured to the rod or rods, and operated on by the arms of a rock-shaft, and the plate or plates with beveled edges, sliding on the said valve rod or rods, said plate or plates being operated on by the governor, and operating on the lifting rods."

109. For an *Improvement in Cotton Pickers;* B. G. Shields, Marlin, Texas.

Claim.—"The application of a fan or fans to the gathering chain, as a means of removing the gathered cotton from said chains."

110. For an *Improved Shingle Machine;* P. O. Sherwin, Jamestown, New York.

Claim.—"The stops, in combination with the notches or teeth on the set wheels."

111. For an *Improvement in Harvesting Machines;* George W. Tolhurst, Cleveland, Ohio.

Claim.—"The combined use of the single row of removable pins, with the adjustable angular slot, for the purpose of procuring a vibratory motion to be applied to the cutters."

112. For an *Improvement in Riding Saddles;* Pascal Plant, Chicago, Illinois.

Claim.—"The sockets and vertical shanks, provided with removable springs."

113. For an *Improved Shingle Machine;* David D. Tupper, Boston, Mass.

Claim.—"The method of arranging and operating the cutter head, whereby the pressure rolls are inclined to correspond to the inclination of the face of the bolt."

114. For an *Improved Construction of Iron Fence Posts and Ties;* John B. Wickersham, City of New York.

Claim.—"1st, The double lipped post or tie cornered or mortised upon opposite and corresponding sides, in combination with the inclined corner key, for holding and crimping the rail. 2d, Constructing the fence tie and key above named, that it may be attached to a wood post, in order to take up the lax tension of wire and flat hoop iron, and thus act as a compensator for the expansion of the metal."

115. For an *Improvement in Self-Acting Rakes for Harvesters;* Jesse Whitehead, Manchester, Virginia.

Claim.—"The combination of the swinging arm and traveling carriage, moving together and independent of each other. Also, the locking arm at each end of its traverse movement, so that the rake cannot swing around, whilst the carriage and raker reciprocate together and discharge the gravel."

SEPTEMBER 23.

116. For an *Improved Fly-Trap;* Samuel Arnold, Green Hill, Tennessee.

Claim.—"1st, The employment of the revolving perforated grooved and hollow cylinder, applied in connexion with the reticulated piston and glass vessel. 2d, The arrangement for retaining the piston elevated while the flies are being entrapped, in connexion with the device for releasing it when necessary."

117. For an *Improvement in Ovens;* Hosea Ball, City of New York.

Claim.—"The perforated interior chamber, in combination with the rotary reel and the swinging platforms thereon self-discharging."

118. For an *Improvement in Reefing Top-sails;* Isaac Boss, Brooklyn, New York.

Claim.—"1st, The running of lines from the reef between the head of the top-sail and the fore part of the yard, thence direct to the topmast head. 2d, The arrangement of reef tackle beneath the yard, running from the end of the yard to the quarter on deck. 3d, The peculiar mode of strengthening the sail by bands and double ropes."

119. For an *Improvement in Corn Planters;* Malender Bates, Carlton, New York.

Claim.—"The rotating ratchet wheel, provided with feeding apertures, in combination with the wire screen, the spring pawl, the guard pin and wire button."

120. For an *Improved Method of Feeding and Sawing Shingles;* George Craine, Fairfield, Iowa.

Claim.—"So arranging the carriage with regard to the saw, as that the saw shall enter the bolt at or near the centre in length of the shingle, and cut towards both its ends at the same time. Also, as a device for feeding the bolt to the saw, so as to take the shingles therefrom 'but and point,' alternately, the worm wheel working into the double racks. Also, the combination of the hinged piece, with its pin and feeding tooth, and the ledge and trigger on the fixed piece, for the purpose of connecting and disconnecting at proper times, the carriage with the feeding shaft, so that it may traverse on its ways."

121. For an *Improved Stave Jointer;* A. H. Crozier, Oswego, New York.

Claim.—"The wheel with cutters attached, in combination with the adjustable gauges or plates."

122. For an *Improved Mode of Adjusting the Slats of Window Blinds;* Benajah C. English, Hartford, Connecticut.

Claim.—"1st, The manner of adjusting the slats of window blinds, by the use of the gear wheel and rack. 2d, The method of fastening the slats at any required angle by the use of the clutch. 3d, The whole in combination."

123. For an *Improved Machine for Painting Carriage Wheels;* S. B. Fuller, Worthington, Mass.

Claim.—"The vibratory and rotating shaft passing into the tub."

124. For an *Improved Explosive Shell;* A. M. George, Nashua, New Hampshire.

Claim.—"The arrangement and combination of the chambers, to constitute a new projectile for the scattering of melted metal or other incendiary substances."

125. For an *Improvement in Feed Rolls of Straw Cutters;* Alexander Gordon, Rochester, New York.

Claim.—"The construction and arrangement of the feed roller and shaft."

126. For an *Improvement in Metallic Braces for Heels of Boots and Shoes;* George W. Griswold, Carbondale, Pennsylvania.

Claim.—"The application to boots or shoes of a brace or support, for uniting the heel and counter, and to prevent one from twisting or running over on the other."

127. For an *Improved Device in Machines for Manufacturing Bed-Pins;* Henry Gross, Tiffin, Ohio.

Claim.—"Fixing the head forming V cutter, to a lever operated by a longitudinal movement of the pin, whereby but one hand of the operator is required for forming the entire pin."

128. For an *Improved Hand Stamp;* Charles W. Hackett, Elmira, New York.

Claim.—"The arrangement of a rotating printing press, with two sets of type alternating with each other, in such manner, that at the same time one set of type is leaving its impression, the opposite or corresponding set is being supplied with ink."

129. For an *Improvement in Corn Shellers;* James J. Johnston, Alleghany, Penna.

Claim.—"The drum, with the two sets of teeth, and its combination with the vertical guide boards and spring plates."

130. For an *Improvement in Brick Machines;* William A. Jordan, Thibodeaux, La.

Claim.—"The tables and shoving heads, in combination with the rotary scrapers, and curved guards."

131. For an *Improvement in Manufacturing Ingrain Carpeting;* David B. Kerr, City of New York.

Claim.—"A parti-colored ingrain carpet, in which the warp threads of one or more plies are parti-colored in whole or in part, and are combined with solid colored weft threads to form the design."

132. For an *Improved Machine for Notching Hoops;* Daniel Lamson, East Weymouth, Massachusetts.

Claim.—"The knife attached to the reciprocating frame, in combination with the inclined plate attached to the frame."

133. For an *Improved Omnibus;* D. O. Macomber, City of New York.

Claim.—"The arrangement of two series of independent seats on each side of the carriage body. Also, connecting the body with the frame of the running gear, so that it will rock thereon, in combination with the screw bolts and adjusting nuts at the ends, for the purpose of setting the body at any desired inclination with the frame of the running gear. Also, connecting the brake levers with the shaft of the stop and foot wheel, in combination with the strap which passes into the inside of the carriage body to be operated by the passengers if required."

134. For an *Improvement in Securing Spokes in the Hubs of Wheels;* Robert Moor, Westport, Indiana.

Claim.—"The oblique form of spoke mortise, enabling all the necessary beveling and taper of the spoke to be on that side which is in advance when the wheel is rotating forward, leaving the 'rear' side straight for its entire length, thus adding to the strength and reducing the labor of constructing the spoke."

135. For an *Improvement in the Air Engine;* Thomas McDonough, Middletown, Connecticut.

Claim.—"Combining the hot and cold cylinder (or cylinders,) by an interposed cylinder to prevent the one from being affected by the temperature of the other. Also, the working piston (or pistons) working in the cold cylinder, in combination with the dumby piston (or pistons) which extends from the cold to the hot cylinder. Also, the vertical position of the pairs of cylinders, that the heated part of the engine may be above the cold parts, in combination with the means for keeping the lower part of the engine cold. Also, the arrangement of the metallic surfaces through which the air or other gas passes, by making such metallic surface of sheets of wire gauze rolled up and placed in a surrounding vessel, so that the air or other gas shall pass in films between the several coils, in contradistinction to passing through the meshes of wire gauze."

136. For an *Improvement in Making Brass Kettles;* O. W. Minard, Waterbury, Connecticut.

Claim.—"The use of rotary shears or cutters, having a hinged or sliding piece constructed and operating to carry one of the shafts and one of the cutters from a cutting position, and to quickly and accurately replace it when desired."

137. For an *Improved Machine for Grinding Saws;* Albert S. Nippes, Lower Merion, Pennsylvania.

Claim.—"In combination with the face plate of a machine for grinding saws, a guide

pattern or former, which can be used for giving shape to the saw plate, by causing the face plate or stone to approach or recede from each other, to vary the bevel or thickness of the saw plate, or to compensate for the wearing away of the stone whilst acting on said plate, or both."

138. For an *Improvement in Blow-pipes;* Steward B. Palmer, Tully, New York.

Claim.—"The two wind-chests connected by the pipe, provided with the faucet, when said chests thus connected are arranged and used in connexion with the pump, reservoir, wick tubes, and nozzle, connected with the pipe."

139. For an *Improved Lubricator;* Norman W. Pomeroy, Meriden, Conn.

Claim.—"So constructing and connecting the disk, which forms the bottom of the oil vessel, that by reason of its curved or waving shape, the central part may be readily pressed inward by the thumb or finger, while its shape will cause it to return to its orinal position, immediately on removing the pressure."

140. For an *Improvement in Cast Iron Pavements;* George M. Ramsay, City of N. Y.

Claim.—"The iron hexagonal paving blocks with legs or lugs below, when united and secured by the iron clips or bands, so as to form the flexible pavement."

141. For an *Improvement in Hay Rakes;* Isaac J. Robbins, Penn's Manor, Penna.

Claim.—"The hinged arms with their revolving teeth, in combination with the sliding blocks."

142. For an *Improved Hydraulic Brick Press;* Ethan Rogers, Cleveland, Ohio.

Claim.—"The employment or use of two pumps with the mechanism for working the same under different pressures, when arranged to operate in relation to each other and mould, for the purpose of pressing and removing the brick."

143. For a *Self-Regulating Draft for Chimney Tops;* Josiah A. Boyce, Lee, Mass.

Claim.—"The application to the top of a chimney or a draft flue of a frame, having one or more turning slats or dampers hung in it, said frame being provided with a rudder, so as to be always turned to a proper position by the action of the wind, and the dampers being combined with a spring mast with sail on top, so as to be closed more or less by the action of the wind, and automatically opened during a calm."

144. For an *Improved Hoop Machine;* Joseph and Sylvester Sawyer, Fitchburgh, Mass.

Claim.—"The methods of hanging the knife and connecting it with the feeding rolls, for the purpose of retaining it midway between the rolls, and parallel with the direction of the hoop pole."

145. For an *Improvement in Carding Engines;* A. D. Shattuck, Grafton, Mass.

Claim.—"The application to the main cylinders of carding engines of two or more variable cylinders, in combination with a doffer."

146. For an *Improvement in Lanterns;* Sinclair Shannon, Buffalo, New York.

Claim.—"Connecting the lamp pot to the main body of the lantern by the bail."

147. For an *Improvement in Lock for Freight Cars;* Thomas Slaight, Newark, New Jersey.

Claim.—"The hasp, fitted over the socket of the lock, and secured thereon by the plug or bolt, which passes through the hasp and socket into the lock."

148. For an *Improvement in Carding Engines;* A. D. Shattuck, Grafton, Mass.

Claim.—"The stripper, in combination with the doffer, and with a main cylinder of a carding engine."

149. For an *Improvement in Grain Separators;* Hamilton E. Smith, Philadelphia, Pennsylvania.

Claim.—"The arrangement of the vertically vibrating shakers, and horizontally vibrating screens, for the purpose of separating grain and other material."

150. For an *Improved Grain Threshing Machine;* Isaac S. Spencer, Guilford, Connecticut.

Claim.—"The cylinders provided with ribs or flanches, placed obliquely or angularly with their axes."

151. For an *Improvement in Churns;* Franklin Thorpe, Shelbyville, Illinois.

Claim.—"The arrangement and combination of the fast and loose buckets, the latter being slackened from the former in the act of opening, and tightened to it in the act of closing, by the screw upon the spindle."

152. For an *Improved Tool for Forming Grooves around the Orifice of Bottles or other Vessels, made from Plastic Substances;* Amasa Stone, Philadelphia, Penna.

Claim.—"The revolving flanch, constructed and arranged to form a groove in the end of the bottle nose or other vessel."

153. For an *Improvement in Feather Edge Gauges;* G. G. Townsend, Rochester, New York.

Claim.—"The combination of the knife and feather guard."

154. For *Improved Devices in Sawing Machines;* William P. Wood and Samuel De Vaughan, Washington, D. C.

Claim.—"1st, The arrangement of the driving beam, in combination with the rocking beams. 2d, The arrangement of the fluted feed rolls, in combination with a reciprocating wedge-shaped saw blade. 3d, The wedge-shaped saw blade."

155. For an *Improvement in Warm Air Furnaces;* William M. Wright, Pittsburgh Pennsylvania.

Claim.—"1st, The manner of increasing the radiating surface by the use of the movable plates. 2d, The manner of constructing the ash-box with its rim to receive the fire pot, and projecting arms or supports."

156. For an *Improvement in Machines for Sawing Marble;* Alonzo Webster and D. K. Bennett, Montpelier, Vermont.

Claim.—"The combination and arrangement of the movable stirrups, cross bars, and the arbors, in the reciprocating frame."

157. For an *Improvement in Boat Oars;* Rufus Rode, Manchester Township, Assignor to John Denig, York, Penna.

Claim.—"The combination of the oscillating plate and double jointed arms, forming a double jointed boat oar, operating on an oar or rower box, for the purpose of enabling the oarsman to row forward with his face fronting the bow of the boat."

158. For an *Improved Belt Punch;* Augustus Simpson, Worcester, Assignor to Samuel H. F. Bingham, Weston, Mass.

Claim.—"The combination and arrangement of the tit and the cutter, whereby the conical form is given to the article punched, the cutting facilitated, and performed with the edge of the cutter free."

159. For an *Improvement in Reaping and Mowing Machines;* William P. Wood, Assignor to self and Samuel De Vaughan, Washington, D. C.

Claim.—"A balance frame, supported and turning upon an axis of motion back of the axis of the driving wheel, when used in connexion with the angular or oval-shaped gearing, or its equivalent, and the bifurcated stanchion brace, in combination with a main frame, rigidly supported at its forward end upon a truck carriage or wheels."

SEPTEMBER 30.

160 For an *Improved Fire Arm;* Joseph Adams, Cleveland, Ohio.

Claim.—"The employment of a revolving barrel formed from a single piece of metal with three bores of equal diameters, or four bores in opposite pairs of unequal diameters, when so arranged that the bores are located as near together as practicable, to secure the proper strength of dividing metal, while the relative positions of said bores are such that their outermost tangents shall revolve in a common circle around the central point between them, and be equidistant apart, the outer periphery of the barrel, also, so conforming to the bores as to dispense with unnecessary metal, for the purpose of securing the utmost compactness, lightness, symmetry, and strength, with a given capacity, and at the same time of retaining perfect convenience in respect to revolving and discharging. Also, the employment (instead of separate breech pins,) of a single breech piece, provided with branches or pins fitting the several bores, and secured therein by a right and

left nut. Also, the socket, in combination with the breech piece and collar. Also, the peculiar construction, arrangement, and combination of the hammer, main spring and trigger, as adapted to the rest of the gun, and operating both to hold the hammer cocked and down upon the nipple, till set free by moving the trigger."

161. For an *Improvement in Brick Machines;* Henry Brad, Greencastle, Indiana.

Claim.—"The self-adjusting frame, for the purpose of removing the brick from the moulds into the apron after they are pressed, operated by means of spring and projections on the revolving journal."

162. For an *Improvement in Grid-Irons;* William Bennett, City of New York.

Claim.—"The pins or elevators attached to the bars or seats of the grid-iron, used in connexion with the ventilating cover."

163. For an *Improvement in Locks;* George W. Coppernoll, Ohio, New York.

Claim.—"1st, The swinging guards in front of the bolt chamber, actuated by the fixed portion of the key, in combination with the sliding guards, actuated by the secondary key. 2d, The eccentrics, arranged relative to each other and the bolt, and actuated by the secondary key, after the removal of the guards. 3d, The combination of the swinging guards, tumblers, and spring catches."

164. For an *Improvement in Self-Heating Smoothing Irons;* William D. Cummings, Washington, Kentucky.

Claim.—"The trough extending rearward from the bottom of the fire space, in combination with the ash receiver, open at the side next the said space, and provided with a registered top, for the purposes of cleanly separation and removal of the ashes, &c."

165. For an *Improved Mode of Hermetically Sealing Bottles;* Mills B. Espy, Philadelphia, Pennsylvania.

Claim.—"The improvement of the two part screw collar, for the purpose of drawing down and holding the cover over the mouth of the bottle, so that the said bottle shall be hermetically closed by the cork, or its equivalent, being compressed upon the upper edge of the lip of the same."

166. For an *Improvement in Steam Boilers;* David H. Fowler, New Orleans, La.

Claim.—"The arrangement of the central and exterior flues with the open space and apertures."

167. For an *Improvement in Journal Box Alloys;* John Fidler, New Albany, Indiana.

Claim.—"The composition of the ingredients above named."

168. For an *Improved Wind-Mill;* Marcus Frisbee, Rensselaerville, New York.

Claim.—"The combination of the spring on the sails, with the adjustable or shifting straps, operated by the lever."

169. For an *Improvemnt in Mixing Wheat Flour with Paints;* Isaac Gattman, Philadelphia, Pennsylvania.

Claim.—"The manufacture of paints by grinding crude colors in a composition of water, flour, or its equivalent, rosin, or its equivalent, fish oil, or any drying or undrying oil, in order that the paint thus manufactured may be produced at a cheap rate, and afterwards thinned with water to the required consistency."

170. For an *Improvement in Machines for Softening Leather;* John Greenleaf, Lowell, Massachusetts.

Claim.—"The combination of the blade, with the cylinder and apron carriage, for softening and graining leather."

171. For an *Improvement in Brick Machines;* Joseph A. Hill, Greencastle, Indiana.

Claim.—"The drum provided with the pinion, and arranged to operate relatively with the rock bar and pinion, for the purpose of reciprocating the carriage."

172. For a *Photographic Instrument;* Daniel J. Kellogg, Rochester, New York.

Claim.—"My method of converting the canvass itself into a basin, by means of the metal ring."

173. For an *Improvement in Seed Planters;* B. Kuhns, Dayton, Ohio, and M. J. Hains, Delaware City, Delaware.

Claim.—"The combination of the cell and pocketed roller, with the pocket clearer actuated by the rotation of the roller."

174. For an *Improvement in Saw Gummers;* Samuel J. Lewis and William Alston, Bordentown, New Jersey.

Claim.—"The punch, in combination with the die, the same being arranged in the carriage, so as to rotate and operate together."

175. For an *Improved Portable Fence;* G. R. McIlroy, Oakdale, Indiana.

Claim.—"The supporting the panels on the top of the bases or braces, so as to allow of their being moved sidewise at the bottom sufficient to bring them into a perpendicular position on uneven ground, and securing the same by means of pins or wedges passing between the end batten of each panel immediately above the bottom rail or board through one or a number of holes in the base or cross board at the bottom of the base, which holes are placed in a circle corresponding to that which the bottom of the panel describes by moving it sidewise."

176. For an *Improvement in Excavators;* S. G. L. Morrow, Linn, Missouri.

Claim.—"The arrangement of the cutter elevator, and discharge chute, with the levers regulating the same."

177. For an *Improved Machine for Sawing Marble in Taper Form;* M. M. Manly, South Dorset, Vermont.

Claim.—"A machine for sawing marble in angular or tapering forms, by means of two horizontal saw frames or gates, with adjustable guides run in connexion one above the other, with the saws running and working in one plane."

178. For an *Improved Steam Wagon;* John Percy, Albany, New York.

Claim.—"1st, The two trucks, attached to the underside of the frame, connected by the perch, and turned by means of the rods, which are fitted in the inner ends of the frames of said trucks and connected to the rack, or an equivalent device. 2d, Connecting the axles of the wheels with the connecting rods of the steam cylinders by means of the gearing and cranks. 3d, The arrangement of the trucks, frame, steam cylinders, boilers, and the device for turning and guiding the trucks."

179 For an *Improvement in Machines for Finishing Leather;* Joseph Pyle, Wilmington, Delaware.

Claim—"The combination of the pin block, with its corresponding block, or same as upper block, composed of wood or any malleable metal, the feed rollers composed of like materials, or of wood covered by india rubber cloth, with the corresponding brush rollers, for the purpose of softening leather or skins ready for finishing, or any other materials substantially the same, upon which it will perform the same operation."

180. For an *Improvement in Means for Lubricating the Shear Pin of Ships' Blocks;* John M. Riley, Newark, N. J.

Claim.—"The bands, one or more, interposed between the axis and the eye or band of the pulley, the bands being perforated as shown, and the axis provided with passages or apertures, for the purpose of lubricating the bands and axle."

181. For an *Improved Mode of Attaching Hubs to Axles;* John M. Riley, Newark, New Jersey.

Claim.—"The collars placed upon the arm, in combination with the tube, nut, key, and elastic rings."

182. For an *Improvement in Cultivators;* Luther Robinson, West Cambridge, Mass.

Claim.—"The arrangement consisting of the vertical cutters, horizontal cutter, mould boards, and seed dropper; said parts being placed in relation to each other."

183. For an *Improvement in Locomotives for Roads, &c.;* John Robingson, New Brighton, Pennsylvania.

Claim.—"1st, Combining the sliding bolt by which the sector on the fore truck is locked, with the rotating shaft which carries the gear which operates upon the sector to turn the fore truck, by means of a loose collar and groove, whereby the bolt may be operated by a longitudinal movement of the said shaft. 2d, Fitting the sprocket wheel

to the shaft, which drives the fore wheels with a universal joint to enable it to adapt itself to the direction of the driving chain, when the said shaft is not parallel with the engine shaft, and thus to prevent the chain slipping off the wheel, or being twisted or broken."

184. For an *Improvement in Many-wicked Candles;* Benjamin D. Sanders, Holliday's Cove, Virginia.

Claim.—"A candle constructed with three or more wicks, when said wicks are arranged angularly to each other, or in the path of a circle struck from the centre of the candle, at equal distances apart or thereabouts."

185. For an *Improvement in Seed Planters;* John F. Seaman, Walcott, New York.

Claim.—"The shares, arranged so that they may rotate intermittently, in order to free themselves of weeds, grass, or other incumbrances."

186. For an *Improvement in Bridges;* Isaiah Rogers, Cincinnati, Ohio.

Claim.—"1st, The formation of an arch whose voussoirs consist of one or more ranges of tubes in vertical planes, held in position by the described radial plates with confining flanches, the tubes of each component arc being gradually displayed and enlarged from the crown of the arch each way, the enlargement in one direction and the contraction in the other direction, being such as to preserve a circular section throughout, or gradually ovaling from the haunches by a vertical enlargement towards the ends, and a corresponding contraction toward the centre of the arch, according to circumstances. 2d, In combination therewith, the described mode of staying and bracing together the several ranges of such tubular voussoirs."

187. For an *Improvement in Tailors' Measures;* Amos Stocker, Rome, New York.

Claim.—"The instrument, with the arrangement of the eyelet holes, eyelets, and letters."

188. For an *Improvement in Steam Boiler Grates;* Asbury M. Searles, Cincinnati, Ohio.

Claim.—"1st, The conical grate, formed of diverging radial bars, and having the recurved margin or otherwise. 2d, In the described connexion with a conical grate, the radial series of pokers, having the explained shearing action between the grate bars."

189. For an *Improvement in Trunks;* Stephen F. Summers, St. Louis, Missouri.

Claim.—"The inside metallic strips, arranged in combination with the casters."

190. For an *Improved Ore Washer;* Samuel Thomas, Allentown, Pennsylvania.

Claim.—"In combination with a stationary inclined box, the double shafts with spiral flanches thereon, and turning in opposite directions, for lifting up and carrying forward the ores to the delivery."

191. For an *Improvement for Putting Pillows and Bolsters into their Cases;* David B. Tiffany, Xenia, Ohio.

Claim.—"The instrument having the peculiar construction described, for the purpose of inserting pillows and bolsters into their cases."

192. For an *Improvement in Hydro-Carbon Vapor Lamps;* Thomas Varney, San Francisco, California.

Claim.—"The combination of the reservoir by means of a seal pipe, with the stationary vaporizer containing a circuitous passage."

193. For an *Improvement in Furnaces for Zinc White;* Samuel Wetherill, Bethlehem, Pennsylvania.

Claim.—"Making the whole or a portion of the bed of the furnace to vibrate, but this I only claim when the bed is perforated with numerous small holes, and when used in combination with a forced blast of atmospheric air, which passes to the charge of mixed ore and fuel in numerous small forced jets."

194. For an *Improvement in Artificial Legs;* O. D. Wilcox, Easton, Penna.

Claim.—"The employment of the pulley at the knee joint, as a common centre of motion of the elastic cords, for the purpose of producing a natural movement of the artificial limb. Also, the employment of the sack, whether used in this limb or any other."

195. For an *Improvement in Furnaces;* Richard Wells, Baltimore, Maryland.

Claim.—"The introduction of springs between the supporting plates and the fastenings of the tie rods."

196. For an *Improvement in Disconnecting Railroad Cars and applying Brakes;* Joab Buck, Assignor to self, H. S. Buck, J. W. Kimball, and D. H. Thompson, Fitchburgh, Massachusetts.

Claim.—"The combination and arrangement of the shaft, dogs, hooks, and levers, for the purpose of uncoupling whichever car may be last in the train, simultaneously with the application of its brakes."

197. For an *Improvement in Regulating Valves for Steam Engines;* Henry F. Shaw, Assignor to self and George F. Shaw, Woburn, Mass.

Claim.—"The regulating gates as connected with the valve and the governor."

198. For an *Improvement in Machines for Separating Green Corn from the Cob;* Henry Walsh, Assignor to self and M. N. Espy, Philadelphia, Penna.

Claim.—"1st, The screw shaft and spring lever, when the same are used in combination with the stationary block, and the self-adjusting spring block and its cutter, the said blocks holding the cob between them as it is rotated, and at the same time gradually and regularly moved forward by the progressive rotary action of the screw, and so that the said cutter shall also at the same time operate against the lower edges of the grains of corn in succession, and remove them from the cob in a whole or perfect state, or without crushing or otherwise injuring them. 2d, The combination of the ferrule with the pointed screw end of the shaft."

199. For an *Improved use of the Dash-wheel for Washing and Bleaching;* James Wallace, Jr., Glasgow, North Britain; patented in England, June 26th, 1855.

Claim.—"The use of the dash-wheel, in connexion with the use of the chemical ingredients and steam, for the purpose of washing or cleansing textile fabrics and other materials."

Additional Improvements.

1. For an *Improvement in Rotary Brick Machines;* George Crangle, Philadelphia, Pennsylvania; patented, June 3, 1856; additional patent, Sept. 9, 1856.

Claim.—"The substitution of the single square toothed ratchet wheel, and the pendulous lever, with its spring, for 'rotating and stopping the cylinders of rotary brick machines.' Also, a single cylinder, with two series of moulds in the same, when the said cylinder is constructed with the partition in the middle, and open at each end; the movable bottoms of the moulds thereof being supported at each of their ends by their rims, which are partially supported by the rollers, whilst the roller and its bearings operate between the said two rims."

2. For an *Improved Fire Arm;* Frederick D. Newbury, Assignor to Richard Varick De Witt, Albany, New York; patented, August 12, 1856; additional patent, September 16, 1856.

Claim.—"1st, The placing the hammer and trigger, with their springs, within the arm. 2d, The cocking of the hammer by the movement of the arm and aid of stud, or its equivalent. 3d, The placing of the tape priming under the barrel and in front of the cone, the same to be brought properly on to the cone by the movement of the arm. 4th, The placing of the tape priming, and operating in combination with the arm."

3. For an *Improvement in Fire Places and Fenders;* John W. Truslow, Lewisburg, Virginia; patented, July 15, 1856; additional patent, September 30, 1856.

Claim.—"The construction of a fire place, wherein recesses are formed in the jambs thereof, with hinged folding and expanding wings or flaps attached thereto, forming a fender and a screen, with the springs, together with the double sliding panels."

Re-Issues for September, 1856.

1. For an *Improved Method of Hanging and Straining Reciprocating Saws;* Isaac N. Forester, Centerville, Virginia; patented, October 30, 1855; re-issued, September 2, 1856.

Claim.—"The manner or mode of hanging reciprocating saw-blades, by forming

thereon, or by attaching to the ends and front edges thereof, ears or guide flanches, hook clamps, and shank devices, so that the tension or strain and the draft of the blade will be in a direct line, longitudinally through the base of the teeth and front edge of the blade, whereby the whole of the surface or the plate part of the saw blade is left free, unstrained, and divested of all rigidity and stiffness. Also, the adjustable guide plates, with the slotted or grooved gauge pieces."

2. For an *Improvement in Harness Saddles;* John T. Denniston, Lyons, New York; patented, November 20, 1846; re-issued, September 9, 1856.

Claim.—"Making the upper or saddle part of harness saddles of metal, giving the requisite form thereof by moulding, when such saddles are so formed that the leather parts, such as the skirts, can be secured thereto without stitching. Also, forming the upper or saddle part and the under or crotch part in combination, so that the skirt and jockeys are used, and will be embraced between them, and secured."

3. For an *Improvement in Folding Life Boats;* C. Loche, City of New York; patented, January 2, 1855; re-issued, September 16, 1856.

Claim.—"The chain or chains, or their equivalents, as connected and arranged in relation to the stern and stern posts, ribs, and central frame."

4. For an *Improvement in Machinery for Making Hat Bodies;* Charles St. John, Henry A. Burr, Albert H. Wright, and James M. Riblet, Assignees of Henry A. Wells, dec'd., City of New York; patented, April 25, 1846; re-issued, September 30, 1856.

Claim.—"Forming hats of fur fibres, by throwing the fur in properly regulated quantities, against a section of the circumference of a perforated cone, or other form, as the same is rotated to present in succession every part of the circumference thereof to the current of impelled fur, to obtain the required thickness of hat, in combination with the method of holding the fibres on to the cone or other form during the operation."

5. For an *Improvement in Rotary Pumps;* John Broughton, Chicago, Illinois; patented, June 10, 1856; re-issued, September 30, 1856.

Claim.—"The rotary eccentric piston, working within an oscillating barrel, with arrangement of inlet and outlet passages."

Designs for September, 1856.

1. For *Stoves;* Garretson Smith, Henry Brown, and Joseph A. Read, Assignors to Cox, Hagar & Cox, Philadelphia, Pennsylvania; September 16, 1856.

Claim.—"The design, configuration, and arrangement of the ornaments in bas-relief, constituting the design of the stove designated as the 'Gem.'"

2. For *Floor Cloths;* Antoine Glominski, Assignor to Deborah, Albert E. and Nathaniel B. Powers, Lansingburg, New York; September 16, 1856.

Claim.—"The arrangement of ornamental figures, forming a design for floor oil cloths, or other fabrics."

3. For *Parlor Stoves;* Samuel F. Pratt, Boston, Massachusetts, Assignor to W. and J. Treadwell, Perry & Norton, Albany, New York; September 23, 1856.

Claim.—"The construction and arrangement of ornamental figures, forming together the ornamental designs for the plates of a parlor stove."

4. For *Oven Stoves;* Samuel F. Pratt, Boston, Mass., Assignor to W. and J. Treadwell, Perry & Norton, Albany, New York; September 23, 1856.

Claim.—"The combination and arrangemant of ornamental figures and forms, forming together the ornamental design for the plates of a 'Franklin Stove.'"

MECHANICS, PHYSICS, AND CHEMISTRY.

*On the Silvering and Gilding of Glass.** By J. Liebig.

Silvering Glass.—At the request of M. von Steinheil, the author has made some experiments to discover a process for silvering glass *in the cold*, especially with a view to the production of faultless optical mirrors. The silvering fluid, which perfectly fulfils the desired end, is an ammoniacal solution of nitrate of silver, with an addition of caustic potash or soda, which, when mixed with a solution of sugar of milk in water at ordinary temperatures, deposits the silver on the surface of the glass in the form of a mirror.

To prepare the fluid, 10 grms. of fused nitrate of silver are dissolved in 200 cub. centims. of water, and a sufficient amount of liquid ammonia is added to produce a clear solution. This is gradually diluted with 450 cub. centims. of a solution of potash of spec. grav. 1·05, or with the same volume of a solution of soda of 1·035. On the addition of this, a blackish-brown precipitate is usually produced, which must be at once dissolved by a fresh addition of liquid ammonia. The mixture is diluted with so much water as to bring it to 1450 cub. centims. A dilute solution of nitrate of silver is then dropped in until the production of a strong gray precipitate (not turbidity), when the mixture is brought to 1500 cub. centims. by the addition of water. Each cubic centimetre thus contains a little more than 6·66 milligrms. of nitrate of silver, or 4·18 milligrms. of silver. To produce a clean mirror, the fluid should contain no free ammonia, but this must be completely saturated with oxide of silver. For this purpose some of the solution of silver may be kept back and added at the end; and in this case 1 cub. centim. of the solution contains rather less than 4·18 milligrms. of silver.

The solution of potash or soda must be free from chlorides; pure carbonate of soda or potash must be dissolved in water, and rendered caustic by hidrate of lime previously freed from all chloride by washing with distilled water. The solution is not filtered, but left to stand until it becomes perfectly clear.

Immediately before the application of this fluid, it is mixed with one-tenth to one-eighth of its volume of solution of sugar of milk, containing 1 part in 10 parts of water.

In silvering small concave or convex mirrors, a stick or brass hook is attached to the back of the glass by a resinous cement, so as to enable the glass to be suspended horizontally. It is suspended over a suitable glass or porcelain saucer, with the surface to be silvered about half an inch from the bottom of the vessel, and the fluid previously mixed with the solution of sugar of milk is poured in until the whole surface of the glass is immersed.

For the production of flat mirrors the author recommends vessels of gutta percha, cut out of a flat piece, so as to have a margin of about an inch all round the glass. This is turned up after the gutta percha has been softened in hot water, and the corners are made water-tight

* From the Lond. Chem. Gaz., No. 327.

by the application of a hot spatula or knife. The glass is supported at a distance of half an inch from the bottom of the vessel, by means of small cones of gutta percha at the corners, and the space between the surface of the glass and the bottom is then filled with the silvering fluid. The author admits that these arrangements are very imperfect, and that many improvements might be introduced, but the glass should always be suspended at the surface of the fluid.

The reduction of the silver takes place instantly upon the mixture of the alkaline solution of silver with the sugar of milk; the mixture immediately acquires a dark color. In a few minutes the glass plate appears black; in a quarter of an hour it becomes bright, and the reduction is complete when the fluid between the edge of the glass and the wall of the vessel is covered with a white specular coat of silver. Of course the whole of the silver in the solution is precipitated, and only a very small portion of it goes to form the mirror. The quantity of silver attached to a surface of 226 square centims. was 49 milligrms. The silvering of a mirror of 1 metre square would consequently take 2·210 grms. of silver. The quantity of fluid required to silver a glass of 226 square centims. was 280 cub. centims., containing 1170 milligrms. of silver, so that 1170—49=1121 milligrms. of silver are thrown down in the fluid and on the walls of the vessel; this must be collected, and again converted into nitrate of silver, and some loss is unavoidable.

When silvered, the glass plate is taken out of the fluid, washed with warm distilled water, and dried in a warm place. Care must be taken in removing and washing the plate, not to injure the silver coat with the fingers, as otherwise the water penetrates by capillary attraction through the injured spot, and separates the coat of silver from the glass. When dried, the silver adheres so strongly to the glass that it can hardly be rubbed off with the finger. It forms a very beautiful, somewhat opalescent mirror, which may be converted into a perfect silver mirror, by careful polishing with fine rouge and velvet. A good deal depends on the cleaning of the glass in the production of perfect mirrors.

The distance between the bottom of the vessel and the surface of the glass must be exactly equal throughout, as otherwise the thickness of the coat of silver will be unequal, and the places where it is thinnest will appear darker than the rest. The smallest bubble of air also will cause a small vacancy in the coating, and the author has found it advantageous to moisten the surface of the glass in the first place with alcohol, as this displaces the adherent stratum of air more readily than water.

When placed at the bottom of the vessel the glass plate is just as completely coated, but the whole of the silver in the solution is precipitated upon it in the form of a gray powder, which adheres so strongly that it can only be got rid of by mechanical means, which endanger the mirror itself. The cost is also greatly increased.

Before putting it in a frame, the dry mirror is warmed a little, and coated with a thin colorless varnish. For this purpose a solution of dammara resin in alcohol is very good.

Gilding of Glass.—Glass can only be permanently and brilliantly gilt with the assistance of heat. Gilding effected in the cold is of beautiful

color and lustre, but does not adhere, and detaches itself from the glass by washing with water.

The gilding fluid is prepared by dissolving pure gold in nitromuriatic acid, adding 292 milligrms. of chloride of sodium to the solution for every gramme of gold, evaporating to dryness, and heating the residue until all free acid is driven off. The double salt is then dissolved in water, and water is added until each 100 cub. centims. of fluid contains exactly 1 grm. of gold. 50 cub. centims. of this solution are mixed with 20 cub. centims. of a solution of soda of spec. grav. 1·035, and 300 cub. centims. of water in a glass flask, and boiled until it is reduced to 250 cub. centims.; and another 50 cub. centims. of the solution, mixed with 20 cub. centims. of the same solution of soda and 230 cub. centims. of water, are kept for an hour in boiling water. The two fluids are then mixed together, and must be employed in gilding whilst fresh.

To gild the inside of a glass vessel, a tenth part of its volume of a mixture of 2 parts of alcohol and 1 part of ether is poured into it, and it is then filled up with the hot gold solution. The vessel is then set in water, the temperature of which must not rise above 176° F. In from ten to fifteen minutes its inner surface is covered with a brilliant golden film, and the vessel is removed from the water when its walls are opaque, or exhibit a deep green color by transmitted light.

The alkaline solution of gold is of course always reduced by the alcohol, but the glass only acquires its brilliant golden coat when the fluid is of such a nature that the adhesion of the gold to the glass may be somewhat stronger than that to the water; in the former case the gold is precipitated only on the glass, in the latter only in the fluid. It is very difficult to hit this point exactly, and the smallest error in the mixture renders success impossible. The author adds, that he has obtained the most beautiful gilding by this means, whilst in other cases he has failed entirely, without being able to discover the cause, so that he does not think this method will be of general application. The mixture will only act whilst fresh, when it has a very slight yellowish tinge; by standing it becomes colorless. Alcohol reduces the gold from the colorless fluid with difficulty.—*Liebig's Annalen*, April, 1856, p. 132.

The English journals contain a notice of another method of silvering by M. Petitjean, upon which Prof. Faraday has been lecturing at the Royal Institution. The following very judicious remarks by the Editor of *Newton's London Journal of Arts and Sciences*, indicate the true source of failure in all the various modes which have been patented for silvering glass: Ed. Journ. F. I.

There seem, indeed, two errors of the most fatal kind involved in any attempt to unite silver to glass in a continuous coating, even if the bond of union could be made much more powerful than the present mere attraction of cohesion. In the first place, silver is one of the best conductors of heat, and glass one of the worst; and in the second place, silver expands by the action of heat more than almost any other substance, and glass less than almost any other substance. To think of keeping two such natural opposites in absolute contact under varying conditions

of temperature, is therefore futile: as well might one strive to prevent a soldered bar of silver and platinum from bending, under the same circumstances. When cold is applied to such a combination, the silver must contract more than the glass, and one of two consequences will ensue;—either the glass must bend, or the thin film of silver give way; and this latter result commonly takes place, until the coating in the end becomes broken up into small spangles, and the power of correct optical reflection is lost: hence the use of these silvering processes has been retained within the limits of simple decoration upon small ornamental objects, and there it is likely to rest.

Some persons may indeed imagine that the same objection would apply to any continuous metallic coating, and therefore the ordinary amalgam of tin and mercury must be liable to the same defects: but in reality there is no analogy between the two cases, inasmuch as that the amalgam in question consists, from the moment of its application, of an immense number of crystalline scales of a metallic alloy, the interstices of which are filled with mercury, whose fluidity permits of a free movement of the scales, without for one moment breaking the continuity of the reflecting surface. If heat be applied, the edges of these scales glide over each other like those of a fish, whereas, under the influence of cold, they separate, and the intervening spaces are immediately filled with fluid mercury, in obedience to the law of capillary attraction—the metallic coating remaining perfect under both circumstances: we do not, therefore, expect to see the use of mercury abandoned for that of silver, in the construction of ordinary looking-glasses, how cheap soever the latter process may become.

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*The Gums and Resins of Commerce.** By P. L. Simmonds.

(Continued from page 283.)

East Indian Gum Kino.—This, one of the most useful indigenous gum resins of the East, is the produce of the *Pterocarpus marsupium*, Roxburgh. The gum flows out on longitudinal incisions being made in the bark, which being fleshy and very thick, is easily done. It trickles down in a tenacious semi-fluid form, and is collected in a cocoa nut shell. On exposure to the sun in flat plates, it soon hardens into angular brittle shining fragments, of a bright ruby color, highly astringent, and readily soluble in hot water. The gum changes into a blood red color by alkalies, which, however, destroy its astringent properties. It is precipitated by the salts of iron, silver, lead, &c., and, with sulphate of iron, forms a fine ink. It dissolves readily in water, to which it imparts its own beautiful color.

Another variety of Indian kino exudes during the hot weather from natural fissures and wounds in the bark of the *Butea frondosa*, a very common leguminous tree. It is known in commerce by the name of Bengal kino, or gum butea, being closely allied to the kino of Pterocarpus, in its chemical and medicinal properties. The natives of India use it for tanning, but as it imparts to the leather a red color, it is con-

*From the Journal of the Society of Arts, Lond., November, 1855.

sidered objectionable by European tanners. Kino is commonly used in medicine for its astringent properties, especially in diarrhœa, chronic dysentery, and other such cases.

Amber.—The source of amber was long uncertain; by some it was considered a carbonaceous mineral, but it is now universally supposed to be a vegetable resin, the product probably of a Pinus. It is too well known in appearance to need description. It has several commercial uses. Being commonly translucent, and susceptible of a good polish, it is made into ornaments as necklaces. It is the base of an excellent varnish, and the source of succinic acid, which is employed in chemical investigations. The beautiful black varnish used by coach-makers, is a very carefully prepared compound of amber, asphaltum, linseed oil, and oil of turpentine. Amber often contains insects, flies, ants, spiders, &c., some of which are so delicately formed that they could not have occurred except in a fluid mass, such as a volatile oil or natural balsam. Mr. Wallis, of Longacre, has one of the largest and most interesting collections of these fossil insects I remember to have seen, and they occur not only in amber, but occasionally in the courbaril resin of South America, in copal and anime, and in copal from Accra. In its appearance and physical properties, amber strongly resembles copal, which is often fraudulently sold for it in the Indian bazaars.

We derive our chief supplies from Prussia, where it is thrown up on the coast between Konigsberg and Memel. The imports in the last few years have averaged about 40 cwts. yearly. Large deposits of amber were found a few years ago in some lakes on the eastern coast of Courland, not far from the Gulf of Riga; and in January, 1854, a bed of yellow amber, apparently of great extent, was found on sinking a well at Prague, from which pieces weighing two and three pounds were extracted. The largest block known is in the Royal Cabinet at Berlin, and weighs thirteen pounds.

This fossil is also found in Madagascar, in Japan, on the shores of the Indian Archipelago, and in small quantities on the coast of China. It forms a considerable item of import in the Chinese ports, the greater portion coming from the eastern coast of Africa; its value there formerly was very great as an incense and for ornaments. Transparent yellow pieces are considered the best, and the price in the East, as here, varies according to size and quality; for its color ranges from black and yellow through red and white. A resin called false amber—no doubt a copal—is among the exports from Calcutta to Great Britain to the extent of several tons.

Lac.—This important resinous substance, which comes into our ports from the East Indies in various form, to the extent now of 2500 tons per annum, is obtained from the incrustations made by an insect (*coccus lacca*), similar to the cochineal insect on the branches and twigs of many trees in India, as *Vatica laccifera*, *Butea frondosa*, *Inga dulcis*, *Feronia elephantum*, *Erythrina indica*, *Schleichera trijuga*, &c. The lac is formed by the insect into cells, somewhat resembling a honeycomb, in which the insect is generally found entire, and owing to whose presence stick lac yields by proper treatment a red dye, nearly, if not quite, as bright as that obtained from cochineal, and more permanent.

Lac is found encircling the branches of these trees in the form of a tube, (half an inch to one inch in diameter;) the broken branches, with incrustations at various distances, is called in commerce stick lac, which ought to be semi-transparent. The coloring matter, exhibited by grinding stick lac, and then treating it with water, constitutes seed lac. I have on the table specimens in the various forms, of the crude stick lac attached to branches of various trees, seed lac, lump lac, shellac, thin plates of a yellowish and brown color, known as button lac, thread lac, and bleached or white lac of the shops.

The range of production of this resin is very extended, reaching from Bombay to the Eastern Archipelago, Ganjam, Nepaul, Burmah, the jungles of the Malay Peninsula, and those of Southern India. In the latter district it is not much collected for commercial puposes, although always procurable in the bazaars. The best lac is produced there upon the *Schleichera trijuga*, or cosumb tree, which abounds in the Central Provinces, and yields the coloring matter twice a year. Burt lac is produced in the Rajpootana states, on the *Ficus indica* and *religiosa*, *Zizyphus jujuba*, and *Acacia concinna*.

The resin in stick lac constitutes about 68 per cent.; in seed lac 88 per cent.; and in shellac, 91 per cent. The wax, which forms about 5 or 6 per cent., is analogous to myrtle wax.

Our imports from India in the last twenty years have been :—

Years.	Shellac.	Seed-lac.	Stick lac.	Lac-dye.
	Cwt.	Cwt.	Cwt.	Cwt.
1833	7,784		1,439	2,919
1841	29,056		2,340	10,905
1843	27,790		733	10,700
1844	14,873		1,194	7,636
1845	22,471		187	12,846
1846	9,449	418	293	5,541
1847	8,637	1,953	622	7,418
1848	14,362	34	358	4,449
1849	14,786	60	2,695	13,546
1850	20,245	1,524	9,189	17,930
1851	19,745	3,821	5,317	17,922
1852	16,356	934	3,054	17,139
1853	28,512	402		17,674

Exports from Calcutta. Twelve months ending 31st August, respectively :—

	1855.	1854.	1853.
SHELLAC :—	Ind. Maunds.	Ind. Maunds.	Ind. Maunds.
To Great Britain, . .	26,147	20,659	42,321
To France, ...	8,609	5,951	11,324
To North America, . .	124,630	21,103	11,290
	158,786	47,713	64,945
LAC-DYE :—			
To Great Britain, . . .	13,177	23,323	25,776
To France, ...	1,152	510	3,141
To North America, . .	5,884	799	7,745
	20,213	24,632	36,662

A resinous gum called Alkor Lek (whence the word lac), flows from the *Pistacia Terebinthus*, Linn., in Algeria, which, mixed with other ingredients, is given as a purgative for fowls. It is supposed that this tree would yield good terebinthine. The gum flows so abundantly, even without incision, that it is often dangerous to sleep under the trees.

Under the commercial name of Dragon's Blood, the produce of several species of Dracæna, is imported to the extent of about 100 packages of 1 to 2 cwts. each. In commerce the resin occurs in powder, grains, masses, drops of the size of an olive, and in sticks enveloped in the leaf of the talipot palm. Its chief use is for coloring artificial tortoise-shell and in paints, varnishes, sealing-wax, &c. It stains marble, especially if the stone be heated. The resin is used occasionally in medicine as a tonic and astringent, and also in opiates and dentrifices. Occasionally a brick red powder, known in the East as wurrus, has been passed off here for dragon's blood. This is collected from the seed-vessels of a euphorbiaceous tree, the *Rottlera tinctoria* of Roxburgh, occurring in Arabia, Eastern Africa, and various parts of India. The Chinese esteem dragon's blood highly. It is obtained in Socotra from the *Dracæna draco*, which is usually met with on the hills at the elevation of 800 to 2000 feet above the level of the sea. There are two kinds there, and the best is of a dark crimson color. Jacquin states that the lump dragon's blood is the produce of *Pterocarpus draco*, but this is very questionable. A common kind in the eastern bazaars is the produce of the red astringent fleshy fruit of the *Calamus draco*, or by incisions in the stem, or natural exudations from various parts of the plant. An inferior kind is obtained by boiling the fruits. In the Madras bazaars, dragon's blood ranges in price from £3 to £11 the maund of 82 lbs., according to quality.

Dragon's blood was the cinnabar of the ancient Greeks. In the time of Dioscorides the opinion prevailed that it was the indurated blood of a dragon; and other old authors tell us that the tree received its name from having the figure of a dragon upon the fruit.

A red juice flows from the wild nutmeg on incisions being made into the bark. This hardens into laminated resinous pieces, red and transparent, and forms a variety of the substance known in commerce under the name of dragon's blood. Professor Lindley states, on the authority of Erdlicher, that a species of Myristica, of the Philippines, yields a crimson juice, which is collected from incisions in the trunk, and used as a substitute for dragon's blood, under the name of Durgan.

Gum Guiacum of commerce. This solid and very friable resin, of which a few tons come in yearly, is the produce of the Lignum vitæ tree of the West Indies (*Guiacum officinale*). The color of the resin is yellowish brown, but it becomes green on exposure to light. It is chiefly used medicinally in gout, chronic rheumatism, &c.

The wood being very hard and heavy, is extensively used for making pestles, rulers, and skittle-balls, and various other articles of turnery-ware. The resin exudes naturally from the stem of the tree, and may be seen in all seasons of the year. It is obtained most copiously by wounding the tree, which is usually done in May. Another method is by heat. The trunk and larger limbs being sawn into billets of about three feet long, an angular hole is bored lengthwise in each, and one

end of the billet so placed on a fire that a calabash may receive the melted resin, which runs through the hole as the wood burns. It is also obtained in small quantities by boiling chips, or shavings of wood, in water with common salt. The resin swims at the top, and may be skimmed off.

In the early part of this century we used to receive this resin from Portobello, whence 22 tons were shipped in 1801; now we get it chiefly from St. Domingo and Jamaica. We received from Hayti 54 cwt. in 1849, 447 cwt. in 1850, 78 cwt. in 1851, and 5 cwt. in 1852. It is not in large demand.

The Icica tribe, lofty trees of South America, produce resinous exudations of value in the districts where the trees occur. Of these I have specimens here in the Carana and Tacamahaca resins; and the resin of Perama, another dark resin from Central America. The *Icica Icicariba* or *Amyris elemifera*, produces elemi, which resembles olibanum closely in its properties and uses.

In Demerara, Jamaica, and other quarters, a gum resin, similar to the gum anime of commerce, exudes from the lowest roots of the simiri or locust tree (*Hymenæa Courbaril*) in a vertical direction, in columns or pieces upwards of a foot in length. It may also be obtained by tapping the tree, when in the course of a few days a large solid mass is formed. It forms an excellent varnish, superior to Chinese lac, and is used for the same purposes as copal. It may be obtained in various parts of British Guiana in great abundance. Some was shown at the French Exhibition, of which I have a sample here. It is of a bright color, with a brittle fracture, and is not unlike anime. A courbaril resin from French Guiana was also shown, which was of a bright lemon color, but much coated. A scraped copal from the same quarter, appears to be a good useful resin.

It is very satisfactory to find our colonies and foreign possessions drawing forth their latent energies in so highly creditable a manner. The admirable collection of raw products shown at Paris by the Island of Jamaica, and fitly rewarded with a gold medal, is an evidence of the talent, exertions, and activity displayed by the members of the kindred Society of Arts in that Island. Demerara, Madras, and New South Wales have also made excellent displays, and achieved much for the interests of commerce, science, and the arts.

Fragrant Incenses.—A common use, and one of great antiquity, for many of the fragrant resins, is for odoriferous incenses in temples, &c.

In the East we have the gum Benjamin (the most costly), olibanum (the ancient frankincense), myrrhs, true and false, as the googul, the muthipaul, the doopada resin, and poona rumpoly from a species of Boswellia. What is chiefly sold as common frankincense in our shops is gum Thus. In Trinidad, incense is obtained from the *Trichilia trinitensis*, but the list of fragrant and balsamic resins might be widely extended, and it will suffice to notice a few of the most important commercial resins of this class.

Gum Benjamin—or Benzoin, of commerce, is said to be the produce of the *Styrax Benzoin*, a lofty tree, which grows in Siam, Sumatra, and Java; but, according to some accounts, it would seem to be also obtained from a smaller tree, cultivated in Borneo. The best balsam is

obtained in Siam by incisions made in the trunk of the tree, after it has attained the age of five or six years. The resin is white and transparent at first. About three pounds are given by each tree for about six years. It forms an article of export from Siam. From Singapore, the exports in 1852 were to the extent of 1282 piculs, and 168 piculs in 1853. Java imported last year Benjamin of the value of 176,182 florins. The different varieties bear a price proportioned to their goodness; the finest quality used to range from £10 to £20 per picul of 133 lbs. Benzoin is the frankincense of the far East, and has long been used for incenses in the Roman Catholic, the Hindu, Mahomedan, and Budhistic temples, and probably in the Israelitish worship. Wealthy Chinese fumigate their houses with its grateful odor. Olibanum, which is cheaper, is in similar and more general use in other parts of the East Indies.

The Gum Olibanum of commerce, is the frankincense of the ancients and the luban of the Arabs. In India it is obtained from several species of Boswellia, *serrata*, *thurifera*, and *glabra*. No botanical description appears to have been published of the African tree, although Capt. Kempthorne, Major Harris, and other travelers, furnish some general accounts of it. The tree invariably grows from the bare and smooth sides of the white marble rocks, or from isolated blocks of the same, scattered over the plain without any soil whatever. On making a deep incision into the trunk, the resin exudes profusely, of the color and consistence of milk, but hardening into a mass by exposure to the air. The young trees produce the best and most valuable gum, the older merely yielding a clear glutinous fluid resembling copal, and exhaling a strong resinous odor.

Olibanum was formerly in high repute as a sovereign remedy against inflammation of the eyes, and as an efficacious remedy in consumption. It was also commonly drank as a stimulant in wine. But for all these purposes it has long gone out of use, and is chiefly imported here for re-shipment to the Continent, being bought up by the Greek merchants.

The trees that produce the luban or frankincense are of two kinds, viz: the luban meyeti and the luban bedowi. Of these the meyeti, which grows out of the naked rock, is the more valuable, and when clean picked and of good quality, it is sold by the merchants on the coast for 1¼ dol. per frasila of 20 lbs. The luban bedowi of the best quality is sold for one dollar per frasila. Of both kinds the palest color is preferred. The trees vary greatly in height, but are never above 20 feet, with a stem of nine inches in diameter. Their form is very graceful, and when springing from a mass of marble on the brink of a precipice, their appearance is especially picturesque.

Although the Wursungili range and other mountainous tracts afford an inexhaustible supply of frankincense, it is a mistake to suppose that elevated districts produce the best gum.

Lieut. Cruttenden, in his journey among the Edoor tribes, states that the gum of the large leaf kind of frankincense tree is not much prized. He noticed in his travels many other kinds of gum trees, for which he could find no name, and one of these he considered to be the gum elemi.

The quantity of gum of all kinds annually exported on an average from the Somali country, on the north-east point of Africa to India and the Red Sea, may be stated at 1500 tons.

The wild gum trees in many districts are considered family property, like the date palms in other parts of Africa. Sometimes the young gum trees are transplanted, and thus cultivated they thrive well, and produce largely.

Major Harris describes the Myrrh tree (*Balsamodendron myrrha*,) as growing abundantly on the Abyssinian coast of the Red Sea to the Straits of Bab-el-Mandal, over all the barren hill sides of the low zone inhabited by the Danakil or Adaril tribes. It is called Kurbeta, and there exists two varieties; one (producing the better description of the gum,) being a dwarf shrub with deeply serrated crisp leaves of a dull green, while the other, which yields a substance more like balm than myrrh, attains a height of ten feet, and has bright shining slightly dentated leaves. The myrrh, called Hofali, flows freely from any wound in the form of a milky juice, possessing a perceptible acridity, which either evaporates or becomes chemically changed during the formation of the gum. The seasons for collecting it are in January, when the buds appear after the first rain, and in March, when the seeds are ripe.

Every passer-by transfers such portions of it as he may find to the hollow boss of his shield, and exchanges it for a handful of tobacco with the next slave-dealer whom he meets on the caravan-route. The merchants also of the sea coast, before returning from Abyssinia, send into the forests that gird the western bank of the river Hawash, and bring away considerable quantites of the *Hofali*, which is sold at a high price. The natives administer it to their horses in cases of fatigue and exhaustion. (*Trans. Linn. Soc.*)

Cedar Gum (*Widdringtonia juniperoides*, Endl).—From the various branches and cones of the cedar tree of the Cape Colony, exudes a gum which soon hardens in the air, becomes solid, yellowish, and transparent, and scarcely differs from the gum olibanum of commerce. This cedar gum is locally used for various medicinal purposes, for compounding plasters and preparing varnish.

Bdellium, or false myrrh, is believed to be the produce of *Commiphora Madagascarensis* of Lindley—the *Amyris commiphora* of Roxborough. Googul is the common name for it in India. The gum resin is semi-pellucid and more yellow than myrrh, and a fragrant balsamic resin is also obtained from the tree.

The Doopada resin, or East Indian copal, exuding from the *Vateria Indica* in Mysore, Canara, and Malabar, &c., is used as a fragrant incense in the temples; the quantity procurable is very considerable. Muthipal, the resinous exudation of *Ailantus Malabaricus*, Decandolle, is said to be used as an incense in Cochin and Travancore. A very fragrant gum, the Hyawa, or incense, suitable for pastiles and similar porposes, is also obtained from the *Icica heptaphylla* of Aubl.

The shrub which produces the balsam of Mecca (*Balsamodendron opobalsamum*) is found, according to Major Harris, on the Arabian Coast at Cape Aden, where it is called Beshan, either the original of, or a derivative from, the word balsam. It is the *Balessan* of Bruce, who did not meet with the true myrrh tree. The balsam flows copiously from incision, and the ethereal oil speedily evaporating, a tasteless gum remains.

Balsams.—When in their semi-fluid state, owing to the volatile oil they contain, resins are termed balsams, and the most important commercial balsams are Turpentine (already noticed), Copaiba, Tolu, Peru, and Canada balsams, Styrax or Opobalsamum, and China varnish. The oleo resins are chiefly used as sources of the volatile oils and Gum resins in medicine. An aromatic oil, called oil of gum kikekunemale, is, according to some authors, obtained from a species of copal in the East.

Camphorwood-oil, obtained from *Dryobalanops camphora*, is used largely in Singapore as a substitute for turpentine, and sells at from 7d. to 10d. a bottle. I have several specimens here of the oils extracted from different resins with which Mr. Wallis has obliged me. A bituminous oil, obtained in the volcanic regions of the islands of the Eastern Archipelago, is shipped to Holland, and when distilled furnishes petroleum.

The balsam of capivi is obtained chiefly from *Copaifera guianensis* and *officianalis*, natives of South America and the West Indies. The imports from Brazil in the last five years have averaged 570 cwt.

Storax, copal, and other gums, may be obtained in large quantities from the Indians in the interior regions of South America, and at prices merely nominal. The Balsam of Peru is imported to the extent of five or six tons per annum, being obtained from *Myroxylon peruiferum*. It is, however, obtained in Central America, and not in South America. Twenty-six cases of East India balsam were imported in September from Moulmein. The balsam exudes so abundantly at the proper season from incisions in the stem of the tree that 12 lbs. are frequently obtained in the space of three or four hours. The balsam of tolu is another oleo resin imported to the extent of a few tons from South America. It is used in medicine, and as a flavoring ingredient by confectioners and perfumers. It is the produce of *Myrospermum toluiferum*. Liquid amber, or styrax, is another balsam of commerce of small consumption. Styrax Benzoin, or storax, in tears from Amboyna, from *Styrax officinale*, is a powerful and fragrant balsam, recently imported from the East. It formerly fetched a very high price.

Canada Balsam.—This well known fir balsam is procured from the American silver fir (*Abies balsamifera*). It is naturally deposited in vesicles on the trunk and limbs, and is collected by bursting these tumors and receiving their contents in a shell or cup. The fresh turpentine thus obtained is a greenish, transparent fluid, of an acrid, penetrating taste; it is highly celebrated here for medicinal and other purposes, and is generally designated in England "Canada Balsam." It makes a very fine transparent varnish for water-color paintings, which does not become darker with time, and is much used in wax flower making.

Muscat is a great entrepôt for the collection of gums for re-distribution. About 15,000 to 16,000 maunds of asafœtida are imparted there annually from Persia in Arab vessels, the greater part of which is re-exported to India.

Four thousand maunds of aloes from Socotra, and some of an inferior quality from Mocha and Macula, are also received for re-shipment to India, and 3000 to 4000 maunds of gum ammoniacum from Persia intended for Bombay. The maund is about 28 lbs.

Gum copal is imported from Zanzibar, and some quantities of frankincense, gum galbanum, and gum from Persia and Bassora.

Asphalte is manufactured at home by one or two companies to the extent of two or three thousand tons per annum. Small imports are received from America and the Continent for the use of varnish-makers, but as it does not appear in the trade returns, it is probably included with pitch, of which we receive about 300 or 350 tons yearly. But little of the genuine Egyptian asphalte is now to be met with. There is one prolific source of asphaltum from which little commercial benefit has yet been derived, at least to the extent to which it is susceptible, and that is the Pitch Lake of Trinidad, covering a surface of about a mile in length by an eighth in width. Though the surface is generally too fine to receive a foot-print—just hard enough to cut readily with an axe—there are places where the pitch oozes out in nearly a liquid form. But the pitch is not confined to this locality. There are masses of it extending wider inland, and in several points it reaches to the sea-beach, whence it is shipped in large quantities to America, and some of the West India Islands, to use in building and flagging streets. Near the Lake some of the negroes occupy themselves in boiling down the pitch, some of which is shipped in a pure state, and some, with the addition of lime, exported as mastic. Many hundreds of tons have been taken from the lake, to the depth of about a foot below the surface. The hole is always filled again within two days after the cutting, by the upheaving of the mass. It appears as though billions of tons of pitch had boiled up from the bowels of the earth, from the effects of an immense subterraneous fire, which had been extinguished, and left the asphaltum to cool in enormous bubbles.

Various attempts have been made to apply the inexhaustable store of bitumen afforded by this lake to some useful purpose. It is the best substitute for macadamization yet discovered. Mixed with sand and pebbles it is much used for pavements and the ground floors of houses at the town of Port-au-Spain, a purpose for which it is admirably adapted. The late Sir Ralph Woodford, when governor of the island, tried to obtain carburetted hydrogen gas from it to light a beacon on the tower of Trinity Church. It burnt well, but created such an intolerable stench, that the experiment was obliged to be abandoned. The person entrusted with the trial, however, knew nothing of chemistry. It has been employed to advantage as fuel by the American steamers plying on the Orinoco. It is thrown in the furnace among the wood, fusing too readily to be used alone.

With ten per cent. of resin oil it forms an excellent pitch for vessels. It was used for this purpose so far back as 1593, by Sir Walter Raleigh, who tells us that this substance was then in general use by the various tribes of Indians in the river Orinoco for caulking their canoes. It has been recently coming into use in the manufacture of petroleum. It might, I should suppose, form a base for some of the compressed artificial fuels.

The Earl of Dundonald has long had great faith in its ultimate commercial utility. Twenty or thirty years ago he shipped two cargoes of it to England, but it was found then to require too much oil in order to

render it useful. Lately his lordship has purchased a large tract of the pitch lands, including twenty-six acres of the lake, and has instituted various experiments with the view of substituting the bitumen for India rubber and gutta-percha in the manufacture of water-proof fabrics, covering of telegraph wires, &c. Judging from the specimens of those shown by his agent at Port-of-Spain (Mr. C. F. Stolmeyer), these efforts bid fair to be quite successful. It seems only necessary that the same amount of intelligent enterprise should be directed to the subject in order to render this wonderful reservoir of bitumen a source of great individual profit and of essential service to mankind. If it could be brought into extensive commercial use for pavements and for the ordinary purposes of pitch and tar, Trinidad could easily furnish supplies for the whole world. Persons desirous of information connected with this lake will find good accounts in the *United Service Journal* for January, 1839, by Dr. Thomas Anderson; in Martin's "West Indies," vol. i. p. 191; by Mr. Alex. Anderson, quoted in M'Callum's "Travels in Trinidad," originally given, I believe, in "Transactions of the Royal Society," vol. lxxix. p. 65, and in *Fisher's Colonial Magazine*, vol. iii. p. 43 and 426. The most recent and best account will be met with in a paper by Mr. N. S. Manross, in *Silliman's American Journal of Science and Art*, vol. xx. p. 153 (No. for September, 1855).

(To be Continued.)

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*Description of a Spiral Coil Piston-Packing.** By Mr. David Joy, of Worcester.

[Read before the Institution of Mechanical Engineers.]

The piston-packing, which is the subject of the present paper, was designed by the writer to carry out the principle, which appears to him the correct one, for producing steam tightness with the least loss of power from friction and the greatest economy in repairs, namely, by the use of metal in that form in which it will give out the greatest amount of continuous elasticity, that is, by employing a spring acting through a lengthened space with comparatively slight intensity of pressure, instead of the short and rigid spring or series of springs commonly used in packing metallic pistons.

The piston in which this packing is used is shown in Figs. 1, 2, and 3, and consists of a simple block, into which the rod is screwed and pinned. The periphery of the piston being turned to $\frac{1}{16}$th inch less diameter than the cylinder, a recess is cut in it with a half inch pitch, making 3 inch more than two revolutions, as shown in Fig. 2.

The packing is formed out of a cast iron or brass ring, $\frac{5}{8}$ths inch thick, and $\frac{3}{4}$ths inch larger in diameter than the cylinder. The ring is turned and bored, and being placed on a mandrill, a spiral groove is cut in it with a $\frac{1}{8}$th inch tool, set at $\frac{5}{8}$ths inch pitch, as shown by the dotted lines. This cut being carried through, leaves the ring in the form of a spiral coil of half inch by $\frac{5}{8}$ths inch section, and of about five full revolutions. A portion of this spiral is cut off, equal to two revolutions and $\frac{3}{4}$ths inch over. This is threaded on to the block-piston, and pushed down till it

* From the Lond. Artizan, June, 1856.

drops into the recess, which it exactly fills laterally, as shown in Fig. 3. A sheet iron cramp is placed round the packing, by which it is compressed to the diameter of the piston, which is then placed at the mouth of the cylinder, the ports being protected by small blocks of wood, and the piston is then thrust from the cramp into the cylinder.

The objects aimed at in this modification of packing are to avoid friction by obtaining an elasticity as light as possible, yet sufficient to produce perfect contact with the face of the cylinder to insure steam tightness, and sufficiently continuous to follow up the effects of wear without the necessity of frequent renewal by resetting. And this the writer finds is best accomplished by using a packing which shall consist of the greatest possible length in proportion to its cross-sectional area. No figure meets this requirement so fully as the spiral coil, and the number of coils, or length of packing, can be increased to any extent that may be found advantageous, the elastic action being always in one continuous length.

Fig. 1.

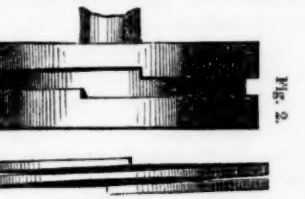


Fig. 2.

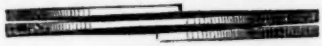
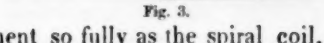


Fig. 3.



As the coil fits throughout its length between the parallel sides of the recess in the piston, its two extremities may recede from each other to any distance that may be found requisite for wearing out the rings without at any time exposing an opening for the passage of steam. The packing under all circumstances fills the recess, except at the bottom, where the vacant spaces at the extremities of the ring, left in the uncoiling of the ring by wear, are effectually closed by the piston body sliding in contact with the cylinder, that part of the packing ring being placed at the bottom side of the piston for this purpose. By experiments it has been found that with the 16 inch brass packing, with half inch elasticity of compression on the diameter, and half inch square section of packing, the pressure on 53 sq. in. of surface of packing was 1·92 lbs. per sq. in., or 102 lbs. on the whole packing. It took 65 lbs. to move this piston backwards and forwards in the cylinder, when disconnected from the rest of the machinery and the glands unpacked, equal to 0·32, or about $\frac{1}{3}$d lb. per sq. in. on the surface of the piston. The 16 inch cast iron packing with $\frac{5}{8}$ths in. elasticity of compression on the diameter, and half in. by $\frac{5}{8}$ths in. section of packing, gave a pressure of 4·41 lbs. per sq. in. of surface of packing, and took 135 lbs. to move it in the cylinder as above, being 0·67, or about $\frac{2}{3}$ds lb. per sq. in. on the piston. This experiment was made immediately after the engine had done her day's work, when the cylinder lids were taken off, and the glands unpacked for the purpose. Previously to unpacking the glands, the steam at 110 lbs. pressure was put on behind the pistons with a most satisfactory result, there being no appreciable leakage of steam past the piston. A similar trial has frequently been made by merely opening the cylinder cocks, and putting steam on behind the piston, when no appreciable blow is observable.

A corresponding experiment was also tried with a 16 inch piston of the ordinary class, having cast iron V packings, and it was found to require 426 lbs. to draw the piston slowly along the cylinder, when disconnected as in the other experiment, showing more than three times the resistance.

The new packing avoids the frequent necessity for "looking at" the piston, which is so large an item in the expenditure of locomotive running sheds, and this is in a great measure a consequence of the accomplishment of the former object, as the large amount of elasticity resident in the coil will wear out the packing without the necessity of examination for renewing that elasticity by means of resetting the springs, as in ordinary pistons.

This piston has also the advantages of simplicity of construction and freedom from parts liable to get loose, and produce breakage of pistons and cylinders. As this packing is used in a block piston, it does away with the necessity for lids, nuts, screws, guards, &c., and reduces the piston to its fewest possible number of parts—the rod, the piston, and the split pin to secure the rod to the piston. The packing-ring also being always confined in a recess of a cross section exactly equal to its own, if broken can produce no injurious effect, as it must always remain in its place as if whole. The time required for removing the packings is very short, the cylinder lid being taken off and the cross head cottor knocked out; the piston is then drawn out, when the old packing is threaded off the piston, and a new one threaded on in ten minutes, and the piston replaced. From the long enduring elasticity of the coils, they are expected to last without examination at least 15,000 miles, the only need for examination being for the purpose of cleaning. There has not yet been time actually to wear out a ring, but as data upon which to form an approximate opinion, the ring marked No. 2, which is exhibited, has run more than 10,000 miles, and when taken out did not blow.

The new packing is also attended with economy in original cost, as the expense of piston and packing shows a considerable reduction on those generally in use.

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*Report on Experiments to determine the Relative Strength of Solid and Perforated Bricks.**

"Sir,—In accordance with your request we have instituted a series of experiments to determine the relative strengths of solid and perforated bricks. To do this, we have deemed it necessary to expose the bricks experimented upon to a transverse as well as a crushing strain. From the results which have been obtained from similar experiments made by Mr. Cubitt and Sir John McNeill, we have every reason to believe that in those trials the *machine*-made perforated brick was tested in comparison with the *hand*-made solid brick, which of course resulted in favor of the machine-made brick; hence the inference has erroneously been drawn that the perforated brick is stronger than the solid. If, however, the comparison is made between machine-made bricks only, it will be found that such is not the case, the solid brick being much stronger than the perforated, as our experiments incontestibly prove.

* From Lond. Journ. of Arts and Sciences, No. 186.

"We have also made experiments with the London hand-made stock-brick, as well as the Staffordshire brick, also made by hand.

"The experiments were made with a 9-inch hydraulic press; the plunger by which the pressure was applied was one inch in diameter, and the weight was suspended to a lever, which multiplied the power 15 times. In applying the transverse strains, however, a shorter lever, which only multiplied the power by 5, was used. The bricks subjected to a crushing force were faced, so as to remove all inequalities; they were then bedded on a sheet of thin lead, and another sheet placed upon them.

"The pressure was communicated by a cast iron plate, so arranged as to adjust itself to the brick, and distribute the pressure uniformly over the whole surface. The weights were carefully applied, and allowed to come to a full bearing before more were added.

"In exposing the bricks to a transverse strain, the supports were placed two inches apart, and the weight gradually applied to the centre by means of a spring balance.

"The results of the experiments are shown in the annexed tables:—

Bricks exposed to Crushing Strain.

No. of Expt.	Description of Brick.	How made.	Weight of Bricks.	Tem. of Kiln.	Crushing Weight.			
			lbs.		tons.	cwt.	qr.	lbs.
1	Worcestershire, perforated,	Machine.	6	30 W.*	45	3	0	0
2	" solid, . .	Machine.	8¼	25 "	52	14	3	0
3	" " . .	Machine.	8¼	30 "	117	5	0	0
4	" perforated,	Machine.	6	30 "	47	17	1	11
5	London stock solid.	Hand.	5¾		13	3	0	0

Bricks exposed to Transverse Strain.

No. of Expt.	Description of Brick.	How made.	Weight of Bricks.	Tem. of Kiln.	Breaking Weight.			
			lbs.		tons.	cwt.	qr.	lbs.
6	Perforated Wors.	Machine.	6	30 W.	3	15	2	20
7	Solid "	Machine.	8¼	30 "	9	3	2	19
8	Perforated "	Machine.	6	30 "	3	5	2	5
9	" "	Machine.	6	30 "	2	3	3	15
10	Solid Staffordshire	Hand.	9½		2	4	0	19
11	" "	Hand.	9½		4	8	0	5
12	" Worcester.	Machine.	8¼	30 "	9	17	0	19

"In experiments Nos. 3 and 4, the cast iron plates through which the pressure was communicated broke with the final strain.

"The brick used in experiment No. 5 was not faced, and as it was 'dished' on the upper surface, the pressure was not uniformly distributed over the surface.

* Wedgwood.

"The bricks termed Worcestershire are those supplied to us by you from the works of the Earl of Coventry.

"We have the honor to be, Sir.

"Your obedient servants,

"HORNER AND MOLESWORTH,

13, *Beaufort-buildings, Strand, June 10th*, 1856. } "*Consulting Engineers.*

"H. CHAMBERLAIN, Esq."

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*On the Employment of Sulphuret of Carbon for Industrial Purposes.**

By E. DEISS.

The author commences by stating, that in 1840 the price of sulphuret of carbon was as high as from 50 to 60 francs the kilogramme, but that soon afterwards he reduced its price so greatly that in 1848 he sold at 8 francs the kilogramme for the purpose of vulcanizing india-rubber. At present, with an apparatus composed of three retorts, he is able to manufacture the immense quantity of 500 kilogrammes of sulphuret of carbon in twenty-four hours; although scarcely a year ago, with the same furnace, the same retorts, and the same amount of fuel, he could only produce 150 kilogrms. in the same time. The product now costs him only 50 centimes the kilogramme, and he has no doubt that, by operating on a larger scale, it might soon be sold at 40 francs per 100 kilogrms. As, however, this substance has at present only a very limited employment in the vulcanization of india-rubber, the author having a large quantity on his hands, naturally desired to find some other purpose to which it might be applied; and considers that he has discovered one of the greatest importance, namely, the extraction of fatty matters.

He states that Paris daily produces 30,000 kilogrms. of bones, which are collected by the *chiffoniers*, and carried to the manufactories of ivory-black and gelatine. Here they are sorted, some being devoted to the production of ivory-black, others of gelatine, whilst some are sold to the workers in bone. The greater part of them (25,000 kilogrms. daily) are employed in the manufacture of ivory-black; but these undergo a preliminary treatment for the extraction of their fatty matter. The bones are broken and boiled with water for about three hours in large caldrons; the fat floats on the surface and is skimmed off; the bones are taken and thrown into a heap, to undergo a kind of fermentation, in which the production of heat induces a state of desiccation which fits the bones for calcination.

In these operations the bone undergoes a great alteration: the long boiling in water dissolves a great portion of the gelatine, which is necessary for the production of a good black; and the fermentation and long exposure to the air causes the almost total destruction of the animal matter, so that a bad black is produced for the sake of only 5 or 6 per cent. of fat.

The author states that much more advantageous results may be ob-

* From the Lond. Chem. Gaz., No. 325.

tained by the employment of sulphuret of carbon. He proposes to crush the bones almost to powder; then to treat them with this agent, which almost instantly dissolves all the grease contained in them; and from this it may be separated by distillation, which is greatly facilitated by the low temperature at which this fluid boils, and the ease with which it may be condensed. The quantity of grease thus obtained is 10 or 12 per cent., and it is superior to that procured by boiling.

He adds, that the same agent may be applied to the extraction of oils from oleaginous seeds and of the grease from wool. In the latter case the grease extracted becomes a useful product; it is a butyraceous substance, adapted for the manufacture of some kinds of soap.—*Comptes Rendus*, February 4, 1856, p. 207.

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*On the Compounds of Carbon and Iron, and their Influence on the Production of Pig Iron.** By A. Gurlt.

The compounds of iron with carbon, which are of such great importance in the commercial production of iron, inasmuch as, owing to the very difficult fusibility of pure iron, it would be impossible to obtain the metal without them on the large scale, belong to that class of chemical compounds in which several atoms of the electro-positive constituents are united to one atom of the electro-negative body; they may therefore be considered as subcarburets analogous to certain combinations of iron with sulphur. The tetracarburet, as it occurs most frequently in the white crystalline pig iron (*spiegeleisen*) or specular iron, and the varieties related to it, has long been familiar to us from the researches of Karsten. In it the iron is completely saturated with carbon, and cannot be made to take up more by prolonged fusion with charcoal. In its pure state it consists of 94·88 parts of iron, and 5·12 carbon, corresponding to the formula $Fe^4 C$. In this compound the whole of the carbon is chemically combined with the iron; it is rarely met with however in a state of absolute purity. In general it contains, in addition to iron and carbon, a variable amount of manganese, occasionally amounting to 6 per cent. As it is most frequently obtained from ores containing much manganese, on the other hand it usually contains a rather larger amount of carbon than the pure tetracarburet. As, however, the manganese replacing the iron in this compound possesses a lower atomic weight than the iron, a certain weight of manganese will combine with a larger amount of carbon than an equal weight of iron; and the amount of carbon which may exist in it without exceeding the maximum for the pure tetracarburet, will depend on the proportion of manganese existing in the specular cast iron.

The pure tetracarburet of iron possesses a specific gravity of 7·65 to 7·66, a silver white color, great hardness, is very brittle, and is commonly crystalline, although its form is of very difficult determination. According to Karsten and Hausmann, it does not belong to the cubic system, but the crystals consist of oblique prisms, among which an oblique terminal plane can occasionally be discovered, so that it would rather appear to belong to the oblique system. The crystals are most frequently tabular, and then appear to be merely rudimentary, intersect-

* From the Lond. Chem. Gaz., No. 327.

ing one another at indefinite angles. Mitscherlich observed an angle of 120°; Rammelsberg one of 116°, also of 130° to 131°; and the author found in a specimen from Silesia, angles belonging to oblique prisms measuring respectively 128° to 129° and 52° to 53°; still the primitive form cannot with certainty be determined from these measurements. The fracture is highly radiate crystalline, and frequently exhibits cavities between the crystalline laminæ. The specular iron is the most fusible of all the combinations of iron with carbon. Its melting-point is about 1600° C., and it becomes solid without previously assuming a thick pasty condition.

The octocarburet of iron, Fe^8C, does not appear to have been recognised hitherto, although it not frequently occurs crystallized in gray pig iron, never, however, in white pig iron. It is distinguished from the tetracarburet not only by its chemical composition, but also very distinctly by its crystalline form and its other physical properties. The crystals which were observed by Karsten, but not further examined, belong to the regular or cubic system, and almost always appear in the form of confused octohedral groups, with the planes not well defined, but the angles occasionally sharp.

The author examined a piece of such crystallized cast iron from the works of Gleiwitz, in Upper Silesia, found in the core of a cast iron gun It presented the following composition:—

Carbon	2·46
Graphite	2·84
Silicium	0·26
Iron	94·20
Sulphur, Phosphorus	traces
	99·76

The absolutely pure octocarburet of iron should contain by calculation 2·63 carbon, and 97·37 iron. In the above specimen, however, a small portion of the chemically-combined carbon was replaced, as has often been observed to be the case, by a small portion of silicium, while the graphite must be considered as mechanically mixed with the iron.

Hence the crystals examined may be considered as a mixture of a carburet of iron and siliciuret of iron, consisting of—

91·548 per cent. Fe + 2·46 C =	94·008 Fe^8C
2·660 per cent. Fe + 0·26 Si =	2.920 Fe^8Si
Graphite =	2·840
	99·768

In the former constituent the carbon is to the iron as 1 : 37·3, and in the latter the silicium is in the proportion of 1 : 10·0, closely agreeing with the calculated composition; and as the octocarburet so largely preponderates in this compound, one is fully justified in describing it as such.

The physical properties of the octocarburet are very different from those of the tetracarburet or specular iron; the specific gravity is=7·15, the color iron gray, the hardness and brittleness much inferior; the former is to a certain degree malleable, as it retains the impression of the hammer when struck, while the latter flies to pieces; the fusibility

of the octocarburet is less than that of the specular iron. It appears to occur frequently, its production being invariably connected with that of gray iron. The crystals are commonly found in the form of pyramids, extending to as much as two lines in thickness, often beautifully iridescent on the surfaces, in the cavities of large castings such as rolls and pieces of ordnance. These crystals, however, are not to be confounded with those regular crystals of soft malleable iron, which are sometimes produced during the oxidizing melting processes, such as refining and puddling; these latter contain no carbon, and are so free from foreign matters that they may be considered as nearly chemically pure iron.

The author believes that similar crystals to those of the octocarburet described above, have been found at the blast-furnaces at the Königshutte in Upper Silesia Ilsenberg in the Hartz, Marienhutte near Zwickau, &c., which have most probably a similar composition; but he has had no opportunity of investigating them more accurately.

As the existence of two distinct subcarburets of iron may be taken as a fact, it will become important to inquire what influence they exert on the production of pig iron. The several varieties of cast iron which are technically received at the iron works, may be brought into two groups, which differ from each other chiefly in their physical qualities. The first group will include all the varieties of white cast iron, which exhibit a silver-white color on the fracture, and a more or less radiate crystalline structure, together with a great degree of hardness and brittleness, and also a relatively high specific gravity = 7·2 to 7·6; and in them no graphite is ever to be distinguished by the naked eye. This group must, however, be subdivided into two subdivisions, determined by their chemical composition, the first of which will include all those varieties of white cast iron, containing a large amount of chemically-combined carbon, amounting to from 4 to 5 per cent., such as specular iron and varieties allied to it. The second subdivision includes all the descriptions of white cast iron containing smaller quantities of carbon, included in the technical term "white cast iron," but which generally contain considerable quantities of sulphur and phosphorus. In the second larger group are included all the varieties of gray cast iron in which graphite can be distinguished by the naked eye, possessing a specific gravity of 7 to 7·2, a granular structure, gray color, and greater toughness, but a less degree of hardness than the varieties of the first group. The gray cast iron must also be separated into two subdivisions, of which the mottled cast iron is the richer in carbon; the other is the gray pig iron proper, containing frequently a considerable amount of silicium. The essential constituents of all pig iron are but two, viz: iron and carbon, the latter in its modifications of graphite and chemically-combined carbon; all the other substances occurring in it may be considered as impurities. Among the electro-positive bodies, manganese is almost always present in cast iron, and at times zinc and copper, which replace an equivalent proportion of the iron; while the electro-negative substances, as sulphur, phosphorus, and silicium, replace the carbon combined with the iron. In proportion to the quantities in which these impurities are present, is their effect in modifying the physical qualities of the metal, such as its toughness and specific gravity.

Hitherto these impurities in the cast iron, which seldom amount to more than 4 per cent., have been neglected in considering its chemical constitution, although Karsten has directed attention to the influence which the electro-negative impurities exercise on the compounds of iron and carbon on fusion. As his experiments throw so much light on the formation of the carburets of iron, it may not be considered out of place here briefly to describe his results.

Karsten found that when cast iron containing the largest amount of chemically-combined carbon, $Fe^4 C$, was melted with sulphur in a covered clay crucible, there was found, on cooling, on the surface, sulphuret of iron, under this a layer of separated carbon in the form of graphite, and under this again a mass of cast iron with the maximum of carbon, proving in a most striking manner that the chemically-combined carbon is separated at the temperature of fusion in the form of graphite from its combination with the iron, and on the other hand that carbon was incapable of decomposing the sulphuret of iron. When this experiment was varied by pouring melted gray cast iron containing only 3·93 per cent. of carbon (of which 3·311 was graphite, and 0·625 chemically-combined) on to sulphur, whose quantity was not sufficient to convert all the iron into sulphuret, or when gray cast iron was melted with sulphur, there was found under the stratum of sulphuret of iron white cast iron with maximum of carbon, the whole of which was chemically-combined with the iron; and when the amount of sulphur was slightly increased, graphite was also separated. From which it is clearly proved, that the carbon in the melted cast iron, on the addition of sulphur, is continually concentrating in that part of the iron not combined with the sulphur until the point of saturation is reached, when graphite begins to be separated.

In the strict analogy to that of sulphur is the action of phosphorus, and also of silicium, which form phosphuret and siliciuret of iron, while the carbon is concentrated in the remaining iron, or the excess separates in the form of graphite. This behavior of the electro-negative constituents of the cast iron will explain the occasional occurrence of graphite in white cast iron, and even in well characterized specular iron; and this appearance is usually to be attributed to the presence of a little silicium, which combines with the iron at a very high temperature, and decomposes a portion of the carburet of iron. In fact, a small portion of silicium is always found in the analyses of white cast iron with graphite. The uncombined carbon, however, exists in such a small proportion in white cast iron as not to be seen by the eye, but is only discovered in its chemical analyses. From the action of sulphur, phosphorus, and silicium, on the carburets of iron above described, it follows that they must be considered as chemically-combined with the iron, replacing the carbon chemically-combined with it.

It is well know that the absolute quantities of carbon are different in white and gray pig iron, even when they are prepared from the same ores and under similar circumstances, the proportion of carbon being always less in the gray than in the white cast iron. The only exceptions to this rule are the varieties of iron produced by remelting in a reverberatory furnace, by which white cast iron can be converted into gray, and *vice versa*. In such irons the altered product usually contains the same

amount of carbon as the material employed originally contained, one portion of the carbon merely passing from one modification to the other, viz: from the state of chemically-combined carbon to that of graphite when the product is gray, or from graphite to chemically-combined carbon when the product is white. In gray pig iron a large proportion of its carbon is not in a state of chemical combination, that is to say, it is in the form of graphite; with white cast iron this is very rarely the case, and those rare cases existing in very minute degree. It was mentioned above, that the conversion of the chemically-combined carbon into graphite was effected by the decomposition of the tetracarburet by sulphur, silicium, and phosphorus; there is, however, another method of separating the carbon from the tetracarburet in the form of graphite, that is, by heat.

It is known from experience that white pig iron may be converted into gray, causing a separation of carbon in the form of graphite, by exposing it to a degree of heat much above that required to effect its fusion; specular iron may even be converted into gray cast iron in this way; now this can only take place when its composition, as tetracarburet is destroyed, and it passes to some lower degree of carburation, setting free carbon as graphite. This high degree of temperature therefore effects this decomposition of the tetracarburet, and slow cooling favors the separation in large flakes; but even when this cooling is rapidly effected, the pig iron contains an equal quantity of graphite, which may be determined by chemical analysis, but which is difficult to be detected by the eye, from its being disseminated in minute particles throughout the mass, and for this reason a gray cast iron rapidly cooled appears to the eye like white cast iron. The degree of heat above that of its fusing point necessary to convert completely the specular iron into gray iron, has not been ascertained with accuracy, owing to the difficulty of measuring such high degrees of temperature; so much experience has taught, however, that in order to obtain gray pig iron, the temperature of the furnace must range far above the fusing point of specular iron.

As the absolute, as well as the relative quantity of carbon in the several varieties of cast iron is different, it may be asked whether it exists in any definite proportion to the iron not combined with any other electro-negative substance. With regard to white cast iron, the view is held that the combined carbon is united to the whole mass of the iron, though not in definite proportions. With regard to gray cast iron, however, it has been assumed that only a proportionally small quantity of the iron was chemically united to the carbon, forming a carburet, which was held in solution as it were in the remainder of the iron which existed in the state of malleable iron; still this soft iron was not to be considered altogether free from carbon, but to contain a minute quantity of carbon combined with it in the same manner as in bar iron. Against this view, which even yet has many supporters, it may be urged, that although it certainly is possible for carburetted iron to dissolve soft iron, as in the natural steel refinery and in the fabrication of cast steel; still the product is steel and not pig iron, and that its production depends upon processes essentially differing in principle from those upon which the production of pig iron depends. Steel is produced under all circumstances, directly or indi-

rectly, by an oxidizing melting process, in which the separation of the sulphur, phosphorus, silicium, and also both the chemically-combined and free carbon, is so far affected by the oxygen of the air, that only a portion of the iron remains in the state of carburet, while the whole remaining mass is in the condition of soft iron. In the production of pig iron exactly the reverse occurs; the melting process is a reducing one, in which the iron is exposed to the action of a large excess of carbon and carburetted gases in the most intimate contact. If it be now considered that the affinity of iron for carbon at high temperatures is very powerful, as the process of cementation sufficiently proves, it must necessarily be admitted that if by any chance soft malleable iron should be present in gray pig iron, it must necessarily unite with carbon to pass again into a combination of iron and carbon, for it is impossible it could exist uncombined under the influence of the reducing gases of the furnace in the presence of the graphite, always intimately mixed with the gray iron.

While therefore we are forced to admit that the iron never exists in pig iron in the condition of malleable iron, but must always be, throughout its whole mass, in a state of combination with the electro-negative constituents, as carbon, sulphur, phosphorus, and silicium, the hypothesis of the existence of a polycarburet, which Karsten and Berthier assumed in order to account for the peculiar properties of crude iron, and which, according to Berthier, would contain 18·3 per cent. of carbon, must fall to the ground, because such a polycarburet could only exist simultaneously with soft iron. But independently of this reason, the hypothesis of a polycarburet is upset by the simple fact, that iron, by taking up rather less than 6 per cent. of carbon, is already saturated; and therefore its combination with 18 per cent. is an impossibility. We may therefore consider it as proved, that the chemically combined carbon is chemically united to the whole mass of the iron not already combined with the other electro-negative substances, and that the graphite is the only mechanical admixture in pig iron. If we are no longer permitted to doubt the existence in every description of pig iron of certain definite carburets, it becomes important to know the combining proportions of the carburets from which these different varieties of cast iron have originated.

In the specular iron, the pig iron containing the largest amount of carbon, these proportions are known: they are those of the tetracarburet, which contains one atom of carbon to four of iron. With regard to the gray cast iron, it is certainly remarkable that the crystalline octocarburet described above should occur so frequently and exclusively in it; and it becomes important to seek herein a close relation between the gray cast iron and the octocarburet. In fact, the following reasons appear to warrant the conclusion, that the carburet of iron existing in gray cast iron is the octocarburet:—1st, the physical properties, as color, hardness, toughness, specific gravity, malleability, agree in both; 2d, the octocarburet occurs very frequently in gray cast iron, and separates in the crystalline form from gray cast iron only; 3d, the tetracarburet (specular iron), at a temperature much above its melting point, becomes converted completely into gray cast iron, in which the proportion of chemically combined carbon represents that of the octocarburet.

If therefore we are authorized in considering the carburet of gray cast

iron as identical with the octocarburet, and we bear in mind that gray cast iron is produced by the decomposition of $Fe^4 C$ at an elevated temperature, it becomes exceedingly probable that gray cast iron is always formed from the tetracarburet. If now the decomposition of the $Fe^4 C$ should not be complete, owing to the necessary temperature not being sufficiently protracted, it is clear that a cast iron will be produced composed of a mixture of tetra and octocarburet, such as the mottled cast iron. Mixtures of octo and tetracarburets of iron are found, however, in other cast irons differing much from the above, and which contain a large amount of white cast iron poor in carbon. This white pig iron, which often contains much sulphur and phosphorus, is always produced at a proportionately lower temperature and with an overcharged furnace. The small quantity of fuel consumed in the reduction of the iron produces this effect: the reduced iron does not remain long enough in contact with the fuel, and the supply of carbonizing gases being deficient, it does not become thoroughly saturated with carbon, and a portion of the iron remains as octocarburet, and is mixed with that portion which has been saturated with carbon to form the tetracarburet.

(To be Continued.)

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*Wetherhed's Method of Superheating Steam.**

The method invented and introduced by Mr. Wetherhed, late member of the United States Congress, for superheating steam, has been submitted to various trials during the last six months, in the dockyard at Woolwich, and has at length assumed a practical form. During the series of experiments to which the system has been subjected, various improvements were suggested from time to time, and it was, therefore, considered advisable to prolong the trials, and if possible to render the system complete. The method was first tried in the *Black Eagle*, Admiralty yacht, and was attended with a considerable saving of fuel; and before the late voyage of the *Dee* to the western coast of England, the machinery was fitted up with the appurtenances necessary for a further test of the system. The apparatus was at work on alternate days during the voyage, which was specially extended for the purpose, and the results obtained exceeded what was anticipated. The economy realized in fuel amounted to no less than 30 per cent. as compared with the ordinary system of using steam. The apparatus consists of iron pipes carried from the steam pipe along the front of the tube plate, and extending into the uptake or chimney, in which they are coiled to increase the surface. These pipes rejoin the steam pipe at or near the cylinders. Part of the steam passes through these pipes, and becomes considerably heated—superheated, as engineers say—and, combining with the ordinary steam before entering the cylinders, brings the mixed steam to about 340° Fahr. It is in this method of passing part of the steam used through coiled pipes in the uptake, and combining it with the common steam, before entering the cylinder, that Mr. Wetherhed's invention consists. The system of simply superheating without mixing the steam has been known for some time past, and has been attempted on

* From the Lond. Mech. Mag., August, 1856.

many occasions, but without much success. In the first course of the experiments at Woolwich a difficulty existed, namely, the burning and consumption of the wadding. This difficulty has, however, been got over.

Account of Experiments made in the year 1856 *on the Resistance Experienced by Screw Propellers when driven at high velocities, and immersed in the River Thames, at different depths.** By GEORGE RENNIE, Esq., F. R. S.

[Read at the Meeting of the British Association, at Cheltenham, on the 8th Aug., 1856.]

It is now nearly a year since, that the author was invited, by Mr. John Apsey, a mechanical engineer, to witness some experiments which he proposed making on his premises, Broadwall (Christ Church), on the power of a double-threaded screw propeller, which he stated to have been invented and patented by him, but which had been previously invented and tried by another person.

The screw, which was fastened on a spindle, was mounted on an old wagon boiler, 6 ft. in length by 4 feet in width, and 4 ft. in depth, one end having a pulley fixed to it, and the other supported on a bracket or stand fixed to the bottom of the boiler. The spindle was allowed to work easily through a bush in the bracket, and also through a stuffing-box let into one end of the boiler, so that when the screw was made to revolve, by driving the pulley, it pressed against the water, and then against the arm of a bent lever, which raised a scale with weights, accordingly. First, the water was poured into the boiler up to the top part of the screw, and afterwards, at the different levels of *one*, *two*, *and three feet* successively.

The screw was driven by a steam engine, at 920 revolutions per minute.

The following were the particulars:—

Diameter of screw,	13⅜ ins.
Pitch of "	7 ins.
Length of "	15 ins.
End area of "	140 sq. ins.

	920 revolutions of screw, the weight lifted.	At one-half, or 460 revolutions, speed of screw.
	lbs.	lbs.
When the water was level with the top of the screw,	67	63
When one foot above screw,	299	88
When two " "	350	112
When three " "	448	126

So that at one foot above the level of the screw the increase of pressure was 4·46 times.
at two feet above screw was 5·22 "
at three " " 6·86 "

While at 460 revolutions, or one-half the speed, the difference was only double, between the screw worked with the water on a level with the circumference of the screw, and when the water was 3 ft. above it.

Thus showing the great effect of working the screw at high velocities.

These results, when shown by the author to the Mechanical Section at Glasgow, in September, 1855, were questioned as to their accuracy, on

* From the Lond. Artizan, Sept., 1856.

the ground that, being made in a boiler, the water was necessarily confined within the narrow limits of the boiler, and the pressures indicated by the screw uncertain. To obviate these objections, a new apparatus was constructed in the month of March last, and fixed in the river Thames, opposite to a wharf in Holland Street, Blackfriars.

The screw propeller, having two blades similar to the common screw used in Government vessels, was fixed on the end of a horizontal spindle, and then driven by a strap connected with a steam engine at the rate of 558 revolutions per minute, and advantage being taken of the rise and fall of the tides outside the cistern. The screw was driven, when immersed, at different depths, and the following were the results of the different experiments:—

	Weight lifted.
When the water was level with the top of the screw, .	49 lbs.
" " 1 ft. " "	252 "
" " 2 ft. " "	343 "
" " 3 ft. " "	369 "
" " 4 ft. " "	—
" " 5 ft. " "	405 "
Here the differences between the first and second numbers are as	1·5
" between first and third, ...	1·7
" " " " fourth, . . .	17·5
" " " " fifth, . . .	18·3

While the numbers are represented by a parabolic curve nearly, thus proving the effects of high speed, when the screw is unfettered by working in a boiler. The conclusions are, that speed is more favorable to developing the power of the screw propeller than depth, and this is more particularly shown by the slight differences of numbers when the screw was working at half speed in the boiler, as indicated also by the curve. If these experiments be borne out on a larger scale, the inference will be that small light propellers attached to the hollow, or after-run of the sterns of vessels, and worked at high velocities, will be preferable in many respects to large and heavy propellers worked at slow velocities in the dead wood.

For the Journal of the Franklin Institute.

Huge Forgings.

One of the cranks intended for Mr. E. K. Collins's new steamer *Adriatic*, was a short time since developed by Messrs. I. P. Morris & Co., from the mass of iron in which it was hidden, by the action of the powerful tools with which their shop is so well provided. The dimensions of the rough piece were 9 ft. 3 ins. long; 4 feet across at widest part; 2 ft. 5 ins. and 2 ft. 3 ins. deep at hub and eye, the middle or web part being depressed a few inches below those parts. Its weight in the rough was 31,544 lbs., which was reduced by finishing to 17,009 lbs.; a great part of the difference having been taken from the hub and eye, which were forged solid in two cylindrical pieces, by a cutter projecting from a boring head. At first sight it might be considered more economical to forge closer; but, the waste of material, consequent from the action of the fire during the long time required to bring such a large mass to a working heat; and, the almost impossibility of getting near enough

to shape it while hot with hand tools, with its awkward form, disapproves that idea. Nearly all the larger forges are now supplied with powerful tools for shaping large unwieldy pieces when cold, consequently they are worked on while hot, only long enough to ensure perfect welding, and to obtain an approach to the desired shape; a closer approximation being made in the rough finishing done by the machines preparatory to the final completion by the more accurate tools of the machinist.

The large chips, too, are worked over again, so that comparatively nothing is lost. The shafts, which weigh 39 tons, cranks and other heavy forgings for the *Adriatic*, were made and furnished (except the one described,) by the Reading Forge Company, their establishment being well supplied with the necessary appliances for such work, having several of Kirk's patent hammers, large and small, a Nasmyth hammer of 5 tons, with large lathes and a shaping machine for rough finishing. The location of the forge is well chosen in the immediate neighborhood of the coal and iron districts, and having canal and railroad communication with the east and the west, it possesses facilities for supplying work cheaper than most other forges, and must become a successful competitor of the old establishments of Boston, New York, and Baltimore, for the heavy work of the machinists of those cities; the work just completed (for one of the largest marine engines built in the United States,) evincing its capacity for the heaviest work. The crank finished by I. P. Morris & Co., was sound and of most excellent material, and if that in the shafts be of the same tough and fibrous quality, the "*Adriatic*" will never be behind her time in consequence of her engines being disabled from that too frequent marine disaster, "a broken shaft." J.

Specification of a Patent granted to Richard Albert Tilghman, *of Philadelphia, U. S. A., for Improvements in the manufacture of Iron.**—[Dated 2d January, 1856.]

It has heretofore been proposed to mix common salt with the ordinary charge of iron furnaces, as it is put in at the top of the furnace; but salt being volatile at a red heat, is vaporized, in great part, by the current of heated gas, and is lost before it can act with full effect upon the materials in the furnace. Now, this invention consists in introducing common salt directly into the lower parts of iron furnaces where the temperature is very high, so that being there immediately vaporized and diffusing itself into the gaseous atmosphere, it penetrates into the pores and cavities of the materials, and in consequence of this great surface of contact, at an intensely high temperature, it produces a more powerful chemical effect.

The salt may be introduced either in the solid, melted, or gaseous form; but the method preferred is to feed dry powdered salt in a constant stream into the blast pipes of the furnace, so that the blast shall carry it at once into the hottest part of the furnace. The proportion of salt used is from about three per cent. and upwards of the weight of the iron and slag produced; but this may be varied according to the nature of the ore and fuel employed. As a general rule, the quantity of salt is increased in proportion to the excess of sulphur in the materials used.

* From Newton's Lond. Journal, September, 1856.

The patentee claims "the introduction of common salt into the hot or lower parts of blast furnaces used in the manufacture of iron."

For the Journal of the Franklin Institute.

Description of Isaac Harman's Brick Machine. Patented August 12th, 1856.

By H. Howson, C. E.

This invention consists in the employment for making bricks of sliding moulds, constructed in two halves, each half having any convenient number of angular recesses and projections. A horizontal reciprocating movement is imparted by means of a crank motion to the moulds, which are arranged to slide in suitable guides. In addition to the reciprocating motion, the two halves of the moulds are caused by means fully described hereafter, during certain points in the movements of the machine, to separate from and come in contact with each other, the points of the angular projections of the two moulds always coinciding, so that the angular recesses of the halves together form oblong spaces of the form and size of the bricks to be manufactured. A knife is used in connexion with the moulds, and so operated by means of rods and levers fully described hereafter, that the moment the moulds are supplied with tempered clay all communication between them and the reservoir above is cut off. To the underside of one half of the moulds is hinged a radial plate, so arranged in connexion with levers and latches, as to open and close during the movements of the machine, when closed forming the bottom of the moulds, and when open allowing the bricks formed in the moulds to escape therefrom; and to the upper side of one half of the moulds is hinged a radial lid, having a plate with projections corresponding in shape to the spaces formed by the angular recesses of the moulds. This lid is alternately raised and lowered during the movements of the machine, raised when clay has to be admitted, and lowered so that in conjunction with the above mentioned radial plate, the clay may be confined to the moulds at the time the two halves of the latter are brought together.

The whole is arranged and constructed for the purpose of manufacturing bricks of a superior quality and that at a rapid rate.

On referring to the annexed Plate, I.

Fig. 1 is a ground plan, showing Mr. Harman's improvements in machinery for making bricks.

Fig. 2, a sectional elevation on the line 1 (fig. 1.)

Fig. 3 and 4, elevations also in section of a portion of the machine with the moving parts in different positions.

Fig. 5 and 6, detached plan views, showing the moulds in different positions.

The same letters of reference allude to similar parts throughout the several views.

The frame-work of the machine is composed of the lower longitudinal beams A and A^1, connected together by the lower cross pieces B, B^1 and B^2; of the upright pieces C, C^1, C^2, and C^3, framed into the longitudinal beam A^1, the upper longitudinal pieces D and D′, secured to the top of the uprights, and upper cross pieces E, and intermediate piece F, which

is framed into E, and which is supported at the opposite end on an upright piece resting on an intermediate piece G below, the latter being secured between the two cross pieces B, and B'. To the top the longitudinal beam D, and that of the intermediate piece F, are secured the boxes *a*, *a*, and *a'*, *a'*, which serve as bearings for the journals of the shafts H and I. On one end the latter and outside the frames is secured a pulley or any other convenient driving apparatus, and on the opposite end is keyed a pinion J, gearing into a cog wheel K, on the end of the shaft H. On the face of the wheel K, and at a suitable distance from the centre, is attached a pin *b*, embraced by the end of the connecting rod L, the opposite forked end of which is jointed to lugs *c*, *c*, on the front half N, of the sliding moulds, the ends of the latter moving in guides M and M', secured to the opposite longitudinal pieces D and D', of the frame-work (see fig. 5). The holes in the lugs *c*, *c*, (through which pass the pins for connecting the forked ends of the rod L to the said lugs,) are oblong, so that the rod may have a slight longitudinal play, independent of the sliding moulds N and N', allowing the latter to have a temporary hesitation or dwell, at each extreme end of its movement, the object of which will be apparent hereafter. The half N of the sliding moulds is connected to the other half N', at each end by means of the bolts *d*, and *d'*, which are so arranged that during the movements of the machine, the projecting points of the two halves of the moulds, may at one time be in contact and at another time be removed from each other a limited distance, as seen in figs. 5 and 6. In order that these projecting points may always coincide laterally with each other and thus allow the intervening spaces to form accurate recesses for receiving the clay, the projection on one half of the moulds slide into corresponding recesses on the other half. On N' are lugs *f*, *f*, to which is jointed the radial lid P; this has a series of openings corresponding in shape and position to the openings formed by the sliding moulds when the two halves N and N' of the latter are in contact with each other. Into these openings fit accurately, but so as to move freely, the projections *h*, on the cover *i;* these projections also correspond in shape and position to the openings formed by the two halves of the sliding moulds, the distance of the outward movement of the projections *h*, is regulated by the heads of the pins *j*, *j*, which are permanently secured to the radial lid P, and which pass through holes in the cover *i;* to the latter is also secured a bent arm *k*, (see fig. 1, and in dotted lines figs. 3 and 4), this will be referred to hereafter.

Underneath the half N' of the sliding moulds are lugs, *m*, *m*, corresponding to the lugs *f*, *f*, above, and to these lugs *m*, *m*, is jointed a radial plate Q, having its upper surface flat, and so arranged that at certain periods during the movements of the machine it shall entirely cover the openings in the sliding moulds as seen in fig. 3; the points of the latches *s*, *s*, jointed to projections underneath the forked end of the connecting rod L, serving to maintain the radial plate in the latter position as long as may be required. To the plate Q, is secured a bent arm *q*, so arranged as to come in contact at the required time with the cross bar R, which connects the opposite guides M, and M', together. I is a shaft having its bearings in boxes *p*, *p*, secured to the opposite beams D, and D', of the frame-work, and to this shaft are secured the two bell crank levers T and

T′, the horizontal arms of which are furnished with counterbalance weights the vertical arms being jointed by means of the links *t*, *t*, to the cutter *v*, (fig. 5), which slides in guides *u*, *u*, attached to the main guides M, and M′, and which has angular projections, formed to coincide with the angular recesses in the half N′ of the sliding moulds. To the top of the vertical arm of the bell crank lever T, and to the same pin which connects the latter to one of the links *t*, is jointed the rod V, the opposite end of which rests on the top of the shaft H, and is so acted upon by a projection *v*, on the latter in conjunction with the weights, as to draw the cutter U, backwards and forwards at the required time. To the guides M, and M′, is secured the reservoir W, for receiving the clay to be formed into bricks. This reservoir is formed of two plates W, and W′, jointed together, and each plate has angular projections and recesses corresponding to those of the two halves N, and N′, of the sliding moulds.

The projections and recesses of the front plate *w*, coinciding with those of the front half N, of the sliding moulds, and the projections and recesses of the back plate *w′*, coinciding with those of the back half N′ of the same, when the latter is brought forward to the position shown in fig. 2, and when the two halves of the mould are separated to their utmost limit.

The bottom edge of the plate *w*, fits just so close to the top of the half N of the moulds, that the latter may move freely, but the bottom edge of the plate *w′*, is so far distant from the top of the front half N, of the sliding moulds, as to allow the knife U, to pass easily.

On the top of the guides M, and M′, are brackets X, having projecting pins on which run loose the rollers *x*, which when the sliding moulds are in the position shown in fig. 4, bear one on each side of the plate P.

Two drums Y, and Y′, run loose on brackets *y*, *y*, secured to the beams A, and A¹. Around these drums passes an endless band, and the whole is set in motion by a strap or cord passing round the shaft I, and around one end of the drum. The properly tempered clay being admitted to the reservoir W, the machine is set in motion by turning the shaft I in the direction of the arrow.

Supposing the moving parts of the machine to be in the position shown in figs. 1 and 2, that is, with the connecting rod L nearly at its outward stroke, and the two halves M and N′ of the sliding mould consequently drawn forward, and separated from each other to their utmost limits, so that their angular projections and recesses may coincide with those in the reservoir, at the same time the radial plate Q has, through the contact of its arm *q*, with the cross bar R, closed the underside of the sliding moulds and the lid P, with the plate I, and its projection *h* has been raised by the arm *k* coming in contact with the pin projecting from the bracket X, at the same time the projection V on the shaft H has caught the end of the rod V, and has withdrawn the knife V from the reservoir. The tempered clay now passes from the reservoir into the space between the two halves N and N′ of the sliding moulds.

On the further movement of the shaft H in the direction of the arrow, the rod V becomes released from the projection, and the counter balance weights will act on the levers T T′ and links *t*, *t*, so as to project the knife V forwards, until its angular projections coincide with the angular

recesses in the half N′ of the sliding moulds, thus effectually separating the clay in the reservoir W from that in the said sliding moulds.

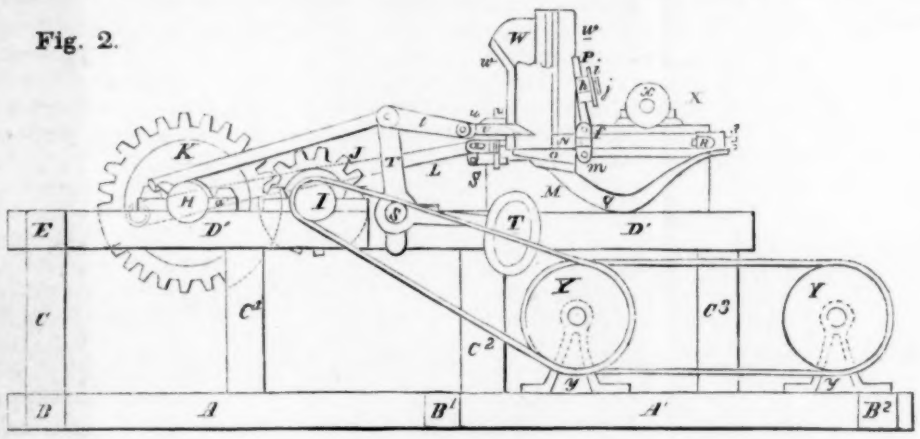
At the time of the releasing of the rod V, and consequent movement of the knife takes place, the connecting rod L has arrived at its utmost outward stroke, and on the further movement of the machine commences its reverse stroke. It does not immediately commence to move the sliding mould, however, on account of the oblong holes in the lugs *c*, *c*, already alluded to. When the pins, which serve to connect the forked ends of the rod L to these lugs, have arrived at the end of the oblong holes, the points of the laches *s*, *s*, have caught underneath the radial plate Q, rendering the latter a permanent base for the clay in the moulds to rest upon. (See fig. 3.)

The sliding moulds, with the clay contained therein, are now carried forwards, until the ends of the elevated radial lid P, come in contact with the rollers *x*, *x*, at the same time the bent lever K, being released from the pin on which one of these rollers is hung, the radial lid P now falls down, and the projections *h h* on the plate *i*, rest on the clay contained in the moulds, the projections coinciding on one side with the angular projections and recesses in the half N′ of the sliding moulds.

The whole sliding mould is then carried forward still further, until the half N′ strikes the points of the set screws 3, 3, in the bar R, when the further progress of this half of the mould is retarded, the connecting rod, however, has not yet reached its utmost stroke, and does not do so until the half N of the mould has been pushed so close up to the other half, that the angular projections of one touch coincide with the angular projections of the other, and the recesses of both combined form a series of oblong spaces or recesses of the same size as the bricks to be manufactured. (See fig. 6.)

It will be observed, that, as the clay which was first admitted to the moulds, when the latter was separated or expanded, is in the present position of the machine confined above by the radial plate P, and projections *h*, and below by the locked plate Q, so that the moving together or contracting of the two halves of the moulds must necessarily condense the clay, and cause it to assume compact masses of the desired form. The connecting rod has now reached its extreme movement and the bricks have been formed in the moulds; it now remains to release them from the same, and drop them on the endless band below. As the machine continues its movements, the connecting rod reverses in the first instance, the latches *s*, *s*, are withdrawn from under the plate Q, which drops down and assumes the position shown in fig. 4. As soon as the pins which connect the forked end of the rod to the lugs *c*, *c*, arrive at the end of the oblong openings, in the latter, then the half N, of the moulds is again removed a limited distance from the other half N′, releasing the bricks, which being now acted upon by the weight of the projections *h*, on the loose plate *i*, fall on the endless band and are carried to the distance required, (see fig. 4.) As the sliding moulds now move back towards the position shown in figs. 1 and 2, the ends of the radial lid P, becomes released from contact with the rollers *x*, *x*, and at the same time the bent arm *k*, striking the pin on which one of these rollers is hung, elevates the radial lid with its loose plate *i*, and projections

Fig. 2.



HARMAN'S PATENT BRICK MACHINE.

Fig. 1.

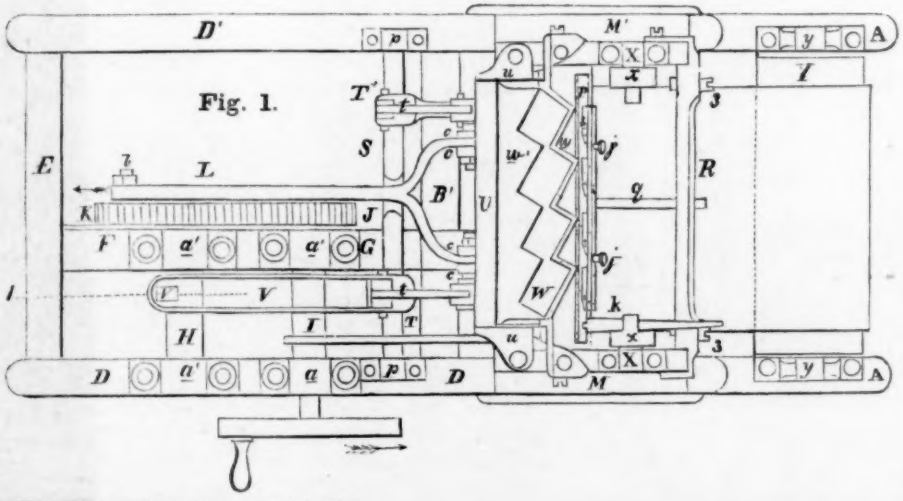


Fig. 4.

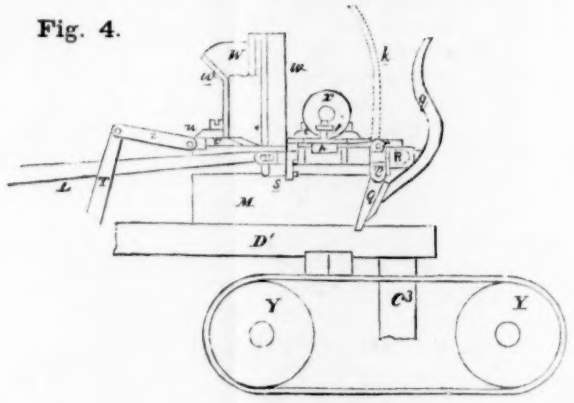


Fig. 3.

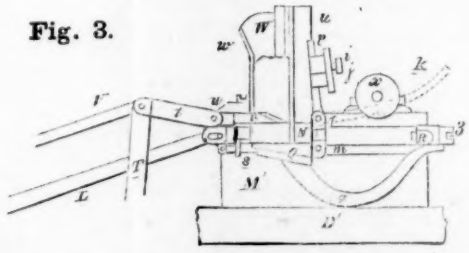


Fig. 6.

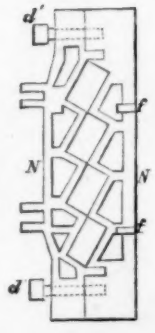
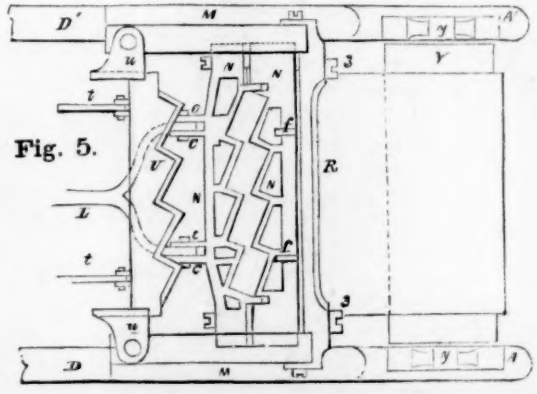


Fig. 5.



DOWSON'S Patent Agency, 55 S. Fourth St., Phila.

h, to the position shown in fig. 2, during the same movement, the bent arm *q*, has come in contact with the bar R, and again closed the plate Q, preparatory to being afterwards caught by the latches *s*, *s*. The projection *v*, on the shaft H, catches the end of the bent rod V, and withdraws the end of the knife U; and thus the moving parts of the machine assume the position shown in figs. 1 and 2, when a repetition of the above described movements takes place. It will be understood that the principal feature in this machine is the arrangement of the moulds, which expand when clay is first admitted, and afterwards contract so as to condense the clay confined in the moulds above and below, into a compact mass, making pressed bricks of a superior quality, and at a rate of speed hitherto unknown.

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*Experiments on Iron made by Mr. Bessemer's Process.**

My Dear Sir,—It may interest you to hear of a few experiments made on the iron produced by Mr. Bessemer, made according to the process now so familiar to all. First, as to mechanical tests—

1. A mass of iron, about 15 inches long by 6½ square, made from Blaenavon pig, just as it came from the iron mould into which it had been poured, was heated in the scrap forge, and reduced to a conveniently sized "bloom" under a one-ton Nasmyth hammer. The appearance of the fracture of this mass, before heating, was similar to that usually described, viz: crystalline, porous, and of a brilliant lustre.

2. The bloom worked very stiff and rigid, and when sufficiently reduced was passed through the rollers, and made into a bar 2 inches wide by 5 thick. Cut with the shears when hot, a good incision was made to about one-third of the thickness, and the remainder fractured in the operation. Another portion of the same bloom was hammered into a short inch square bar under the same hammer, and when cut hot presented the same result.

3. When cold, the first-named bar, once hammered and once rolled, had a nick cut all round, and was broken short off on receiving a blow with a hammer. The fracture clean, laminated as if the crystals were squeezed by the pressure into horizontal layers; no fibre.

4. The two portions faggotted, heated, and hammered into a cylinder of 1 inch diameter; nicked all round, broken with a blow, a clean fracture, no fibre, the first crystalline appearance *restored*, as if the crystals had been simply pressed back by hammering in a direction contrary to the first.

5. The two portions faggotted, heated, and hammered to the same dimensions, a slight nick made on *one* side, fractured by a blow, with the same result. Impressions of the fractured ends were taken in lead, and when compared, at each fracture, had the same appearance, with no increase of fibre.

6. One portion of the last made bar accurately turned, and placed in the machine for testing the tensile strain. A portion of the fracture had an oxidized appearance, which portion was the first to give way, and

*From the Lond. Journ. of the Society of Arts, No. 199.

without appreciable elongation. The iron worked harsh and rigid under the hammer, but well and pleasantly in the lathe. My experiments having been generally with cast iron, I regret not having many with wrought iron for comparison, but you will easily supply them.

The diameter of the specimens at the line of breakage = ·6-inch.

The breaking weights are the means of two specimens, except in that by Bessemer's process, one only being tested.

NATURE.	Breaking weight in lbs. per square inch.	Elongation before fracture.	Diminution of diameter before fracture.	REMARKS.
		Inch.	Inch.	
Wrought iron made from Magnetic ore of Londonderry, Nova Scotia,	66,491	·109	·123	Fibrous fracture.
Wrought iron made from Catalan bloom, hæmatite and specular ore of Londonderry, Nova Scotia,	59,594	·332	·199	Ditto.
Wrought iron made from Magnetic ore of Nictau,	67,905	·232	·146	Ditto.
Wrought iron made from Shell ore of Nictau,	61,039	·234	·204	Ditto.
Bessemer's process (heated and rolled once, heated and hammered four times,) preserving the *laminated* appearance to the last.	65,999	·113	·014	Crystalline partially oxidized.

Chemical Analysis.—A portion of the ingot, taken before making the bloom, selected with great care from a solid inner portion of the mass, so as to avoid cavities, fissures, or fused portions of oxide of iron, &c., was submitted to examination. No silicium whatever was detected. No trace of graphite, or of uncombined carbon. Combined carbon not exceeding 0·3 per cent. Phosphorus 0·44 per cent. Sulphur 0·056 per cent. A similar result was obtained some months ago from a sample produced by the same process by Mr. Bessemer, from another description of iron. Blaenavon iron is comparatively free from these last impurities. For comparison, a pig was taken at random from a heap of Blaenavon iron, which yielded to the same treatment the following comparable result:—Phosphorus, 0·48; sulphur, 0·062.

It appears, therefore, that while the uncombined carbon and silicium had been completely removed by the oxidizing process (their oxidization being probably almost concomitant), the complete removal of the combined carbon is a matter of greater difficulty, and that the phosphorus and sulphur are but little affected. It would appear that when disseminated in small quantities, in a combined state, through large masses of metal, they are difficult of oxidization, and require longer treatment. It is an interesting question as to how long this treatment may be continued before the mass becomes viscid. In the act of pouring it into the mould, considerable quantities rapidly take up their appearance on the sides of the funnel, as if the tendency of the process was to induce that state. I

merely mention this for consideration, and not as supposing the matter is so near complete elucidation that anything definite can be pronounced.

It may be remarked generally, that the above results are only applicable to iron treated in *one* way, *i. e.*, to a *certain* iron which has remained a *certain* time under peculiar treatment. Experiments, accurately made, will show whether *time* is not an important element, that is, when the process must be stopped. As regards the iron made under the above conditions, the experiment is so far useful, if these are recorded. But nothing can be said about the system, as we may be entirely ignorant as yet of the true treatment required. On the other hand, the editor of the *Engineer*, Sept. 5th, states: "We may state that we have ourselves seen several specimens of the metal after being rolled, and which presented all the appearance of the best bar iron." Such a statement from such a quarter, whose duty it is to watch over and record these important matters, enables me gladly to draw the conclusion that there is a system by which the best bar iron can be made under this process, and perhaps he will shortly favor us with particulars. Very truly yours,

Royal Arsenal, Woolwich, Sept. 9, 1856. F. E. W.

P. Le Neve Foster, Esq., Secretary, Society of Arts.

P. S.—Since writing the above, I see in to-day's *Times* a letter from Mr. Bridges Adams, with these words:—"From that ingot has been forged at the Royal Arsenal, Woolwich, a 'bloom,' subsequently rolled into a *tough* bar 2 in. by ½-in., bearing all the mechanical indications of the *best charcoal iron*." The italics are mine. This statement is so clear, that I can only suppose Mr. Adams must perhaps allude to some experiments in the Dock-yard (though I cannot hear of any), because no other than the above have been made in the Arsenal.

For the Journal of the Franklin Institute.

United States Steamer Wabash.

We have obtained from a reliable source, and publish below, the steam log of the United States Steamer *Wabash*, one of the five new frigates built under the recent Act of Congress, on a trial trip from New York to Portsmouth, N. H., on October 1st and 2d, 1856.

The *Wabash* was built at the Philadelphia Navy Yard. Her machinery by Merrick & Sons, of this City, has not been previously described in this *Journal*. It consists of four boilers of the kind known as "Martin's Vertical Tubular," duplicates of those made by the same firm for the U. S. Steamer *Susquehanna*, and described in our number for May last. Two horizontal steeple engines, on deep cast iron bed-plates; of which the cylinders have main balanced slide valves, and independent cut-off slide valve above it, adjustable while the engines are moving. Propeller is of brass, with gearing to hoist it, arranged like those of Penn, in England. The engine room is commodious, affording ample facility to get at all parts of the engines while in motion. At the forward end of the fire room (which is between the boilers,) is a donkey boiler fed by a small Worthington, and two large donkey steam pumps arranged as usual. The propeller shaft has a thrust bearing with several collars, as usual in English propellers,

as also a Parry's conical bearing, on either of which the thrust may be taken at pleasure.

The bearings of the propeller are in wood.

The following are the principal dimensions of ship and machinery.

HULL.—

Length between perpendiculars,			262 feet 7 inches.
" over all,			301 " 6½ "
Knighthead to taffrail,			284 " 0½ "
Beam moulded,			50 " 2 "
" extreme,			51 " 4 "
Depth of hold,			26 " 2 "
Load draft,			23 "
Length occupied by machinery and coal,			60 "

ENGINES—Two—Horizontal steeple.

Diameter of cylinders,		6 "
Stroke " "		3 "
Revolutions per minute,	maximum 50.	
Pressure of steam,	" 18.	
Cut-off, variable 10 inches to 21 inches.		

BOILERS—Four—Vertical tubular.

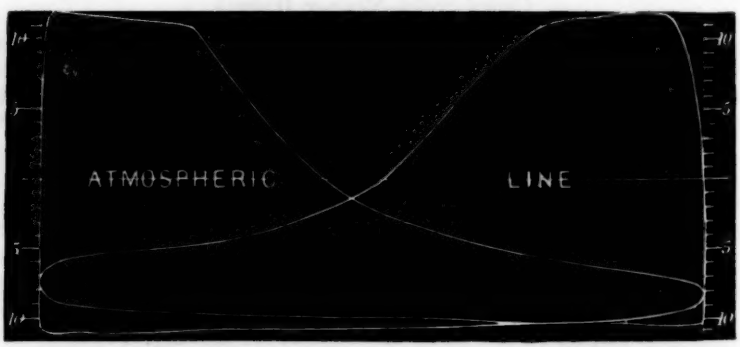
Horizontal area occupied by boilers and fire room,		32 ft. long by 31 ft. wide.
Height of ditto inclusive of steam drum,		15 feet 10 inches.
Top of steam drums above bottom of keel, or 3 inches below load draft of ship,		22 " 9 "
Number of furnaces in all boilers,	20.	
Total grate area,		338 square feet.
Heating surface in tubes,	8508.	
" " furnaces and flat surfaces,	3195.	
Total,	——	11,703 "

PROPELLER—Two bladed, true screw.

Diameter,		17 feet 4 inches.
Pitch,		23 "
Length,		3 " 6 "

For further particulars of boilers see Vol. XXXI, p. 357.

Indicator Card from the Wabash.



Forward Engine, Oct. 2d, 1856, 8·15 A. M.

Revolutions per minute,	45.
Pressure of steam,	15 lbs.
Vacuum,	27
Cut-off at,	10 ins.
Hot-well,	110°

The annexed log affords no indication of the speed which may be attained by steaming alone, as sail was set most of the time; but, it is chiefly valuable as showing the performance of the boilers. The engines worked smoothly, and an examination of the propeller bearings showed no wear.

Abstract of Log.

Hours.	Revolutions per minute.	Pressure of steam.	Vacuum.		Cut-off in inches.	Throttle (8 holes wide.)	Coal in pounds.	Saturation in boilers.			
			For'd.	Aft.				1	2	3	4
A.M.						holes.					
9*		15	28·5	28·5	12	3	2790	1 1/4	1 1/8	1	1
10	46·1	15	28·0	"	12	5	3420	"	"	1 1/4	1 1/4
11	44·3	15	"	"	10	8	900	"	1	1 1/4	1 1/4
12	44·0	14	"	"	10	8	2250	1 3/4	1 5/8	1 1/2	1 1/2
P.M.											
1	40·8	16	27·5	27·5	10	8	5220	1 5/8	1 1/2	1 1/2	1 1/2
2	44·6	10	28·5	28·5	10	8	2520	1 3/4	1 5/8	1 5/8	"
3	44·4	14	"	"	10	8	2160	"	"	"	"
4	48·6	17	"	"	10	5	2250	"	"	"	"
5	46·6	17	28·	28·	10	2 1/2	4770	"	1 3/4	1 3/4	1 5/8
6	48·3	17	27·	27·	10	"	2970	"	"	"	"
7	48·0	16	"	"	10	"	2430	1 5/8	"	"	"
8	44·4	10	"	"	10	3	3600	1 3/4	"	"	1 3/4
9	49·3	12	27·5	27 5	10	"	4500	"	"	"	"
10	49·4	10	"	"	10	8	3060	"	"	"	"
11	49·5	12	"	"	10	"	2880	"	"	"	"
12	48·9	12	"	"	10	"	3060	"	"	"	"
A.M.											
1	48·2	12	28·0	28·0	10	"	4770	"	1 5/8	"	1 5/8
2	46·0	12	27·5	"	10	"	3780	"	"	"	"
3	47·6	15	28·0	"	10	3 1/2	4050	"	"	"	"
4	46·1	15	"	"	10	3	2790	"	"	"	"
5	44·3	12	"	"	10	8	1530	"	"	"	"
6	44·5	12	"	"	10	"	2790	1 5/8	"	1 5/8	"
7	43·9	12	"	"	10	"	3510	1 3/4	"	"	"
8	46·2	14	"	"	10	"	2610	"	"	"	"
9	49·5	14	"	"	10	"	3600	"	"	"	"
10†								"	"	"	"
11								"	"	"	"
12	44·7	10	"	"	21	3	1980	"	"	"	"
P.M.											
1	40·6	12	28·5	28·5	21	1 1/2	2880	1 5/8	"	"	"
2	41·3	12	29·0	29·0	21	"	2160	1 1/2	1 1/2	1 1/2	1 1/4
3	41·8	12	28·0	28·0	21	"	2070	"	"	"	1 1/2
4	46·2	14	27·0	27·0	21	"	2520	"	"	"	"
5	44·3	14	"	"	21	"	4230	1 5/8	1 5/8	1 5/8	1 5/8
6‡	46·0	14	27·5	27·5	21	"	2430	"	"	"	"
Av'e	45·8	13·1	27·8	17·8	12·5	5 1/2	3018	1 5/8	1 5/8	1 5/8	1 5/8

* Passed the light ship off Sandy Hook at 8·30 A. M. † Not steaming.
‡ Passed Cape Ann Light at 6 P. M.

Distance run by chart, . 374 nautical miles.
Time of running, . 33 1/2 hours.
Speed averaged, . . 11 1/6 knots per hour sail & steam.
Under sail alone, . 13 " were at times obtained.

For the Journal of the Franklin Institute.

Particulars of the Steamer "Hiawatha."

Hull built by Messrs. Cooper & Butler, Baltimore. Machinery by Messrs. Murray & Hazlehurst, Vulcan Iron Works, Baltimore. Intended service, between Baltimore and Richmond, Va.

HULL.—

Length on deck,	235	feet.
" between perpendiculars,	225	"
Breadth of beam,	35	"
Depth of hold,	13	"
Tonnage, Carpenter's measurement,	978	"

Frame of white oak and cedar. Truss braced fore and aft.

ENGINES.—One top beam engine.

Diameter of cylinder,	56	inches.
Stroke of pistons,	11	feet.
Diameter of air pump,	44	"
Stroke " "	50	"
Diameter of steam valves,	15 "	14¼ "
" exhaust "	15½ "	14¾ "

Sickel's cut-off (improved).

RADIAL WATER WHEELS—(Iron).—

Diameter,	32	feet.
Face,	9	"
Number of arms,	26.	

One boiler,

Width,	16	"
Height,	14 "	6 inches.
Length,	14	"

Three furnaces; two of them 60 inches, and one 50 inches wide, with two doors to each furnace.

Leading from the furnaces to the back connexion, there are—

4	flues,	21½	inches diameter,	66	inches long.
2	"	19½	" "	66	" "
8	"	8	" "	24	" "

The gases returning to a 66-inch smoke pipe through 166 iron tubes, 4 inches in diameter, and 10 feet long. This plan of boiler was invented by James Murray, Esq., of the above firm, and possesses several new and valuable features in its design.

Each and every part of it is accessible for cleaning or repairs, and from the highly satisfactory results obtained from those now in use, may be classed with (if not superior to,) the best type of boilers now in use.

C.

Extract form the Report of Chas. W. Copeland and H. B. Renwick, Engineers, appointed to Examine "the Fragments of the Boilers of the Grand Trunk Ferry Boat which exploded on the 10th of June, 1856."

From the testimony before the Jury, it appears that the time from the arrival of the boat at the wharf at Longueuil, to the explosion, was from thirty-five to fifty minutes;—during this time the fires probably remained active, as the boat was soon to return to Montreal—further, the safety

valve weights were at the end of the lever, and the two syphon gauges plugged up—so that only the Schaffer gauge remained to indicate the pressure, and this gauge, unlike the syphon gauges, would not attract attention by the escape of steam, or in any other manner, when the pressure had increased above the proper point. It is also testified that there were no cords or chains attached to the safety valves by means of which they could be lifted and sustained to allow of the escape of steam, and further, that these valves were blowing off freely at the moment before the explosion.

Under this state of facts the pressure within the boilers must have been sufficient to lift the valves and have exceeded forty-five pounds to the square inch. The evidence of the Captain is, that the escape of steam heard by others was through slip points separated partially by great pressure. Both accounts are probably true, and either of them indicates an excessive amount of steam.

First, We are therefore of opinion that by a gradual increase of steam while lying at the wharf, the pressure had become more than the safety valves could retain, namely, forty-five pounds to the square inch, on both boilers, and that this pressure had been allowed to accumulate by either the carelessness, ignorance, or recklessness of the engineers, and was too great a pressure to be carried with safety.

Second, Not only had the pressure within the boilers been thus permitted to exceed the limit of safety, but at the same time the water within the larboard and possibly in both boilers, had been allowed to fall below the tops of the flues either by ignorance or inattention, and their upper surfaces had become hot, so that upon starting the engine as testified to by some of the witnesses, the pressure upon the surface of the water was relieved, and the water rising or priming over the heated surface, increased the already unsafe pressure within the boiler nearly instantaneously to a degree beyond the power of resistance of any boiler.

The probability of low water, in the boilers, is further increased when the length of time that the boat had been lying at the wharf with active fires is taken into consideration.

Third, That by the explosion and separation of the larboard boiler, the starboard one received a severe blow or concussion, starting it out of its place, disturbing its water level, and causing a rupture and giving vent to the imprisoned steam, already at the unsafe pressure before mentioned.

Although there is no evidence to that effect, still it is proper that we should mention, that owing to the limited steam room in these boilers, it is quite probable that they primed or foamed very much, and that the engineers may thus have been deceived when the boat was under weigh as to the true height of the water, which by reason of this foaming appears sufficiently high when the boat is under weigh, but settles to a quiescent state at the moment the engines are stopped, and thus exposing a portion of the flues above the surface.

There is conclusive evidence both from testimony and observation that the water had been many times too low in both boilers, and it is at least more charitable to suppose that the engineers might have been ignorantly deceived in this manner, than to believe that want of water had

so frequently occurred during the short time that the boat had been running, through their carelessness or recklessness; unless entirely too ignorant to be trusted at all with the management of the boilers, they must have been aware that the want of water is the most frequent cause of explosion, and that in such event they would most certainly be among the first sufferers.

On all steam vessels the engineers should be held responsible for the proper care and management of their boilers and machinery; they cannot be thus held responsible, nor can proper discipline be maintained, unless all the employees in that department are solely subject to the direction of the engineers in the performance of their duties. The unwarrantable conduct of Payette in directing and controlling the firemen in the performance of their duties, and ordering them to disregard and pay no attention to the directions of the engineers; giving orders entirely independent of, and unknown to them, and even to disobey them, was undoubtedly a fruitful source of trouble and danger. The control of the firemen being thus taken from the engineers, they could place no reliance upon them, or the performance of duties assigned to them, and they were subject to be deceived, and misled by their neglect of duty.

Such an entire want of subordination, system, and discipline in the management of a steam vessel, has never before come to our knowledge, and for this state of things we conceive that Payette is in a high degree censurable, and his conduct furnishes the only extenuation for the mismanagement of the engineers.

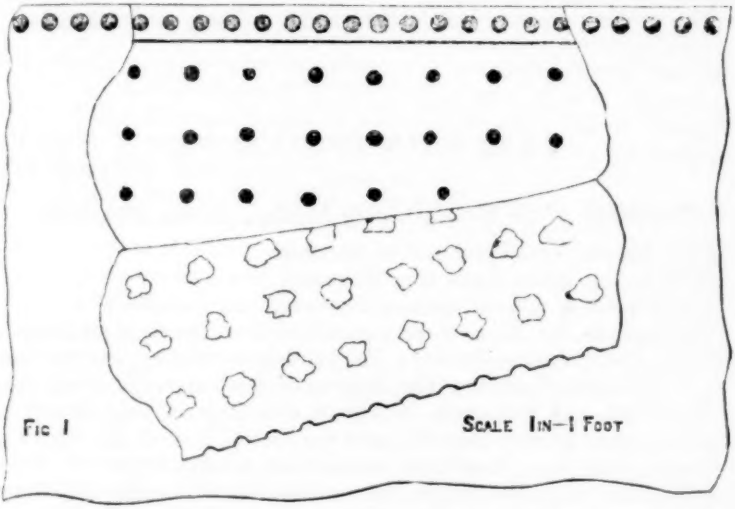
That the whole management of the engineer department of this vessel has been of the most dangerous and reckless character, we think does not admit of a doubt. The plugging up of the steam gauges and continuing to run with them in that state, the entire ignorance of the pressure to which the boilers were exposed—the constant occurrence of scant water in the boilers, and what is still worse, the pumping of water into them while in their heated condition, instead of hauling or wetting down the fires, and the prolonged absence of one or both engineers while the boat was lying at the wharf, with active fires burning and steam up, betray a degree of ignorance or recklessness or both—deserving the severest condemnation.

For the Journal of the Franklin Institute.

Notes on the Late Explosion of a Locomotive on the Baltimore and Susquehanna Railroad.

At the usual hour the fires were started by the night watchman on duty, the engineer having left every thing in readiness the evening previous. Shortly after the fires had been lighted the engineer and fireman arrived, and when a sufficient amount of steam had been raised, the engine was run out upon the track preparatory to an early start with a freight train, and while thus standing (at 3 A. M., Oct. 7,) the explosion took place, by which the fireman was killed, having been thrown some forty yards from where the engine was standing; the engineer escaping with some slight bruises. From the crushed appearance of certain parts of the

forward end of the engine, it must have been thrown nearly perpendicular and then fell across the track. The hindmost driving wheels were thrown completely out of their pedestals and were lying alongside of the engine. The furnace *was spread* apart 12 *inches equidistant from the centre*, breaking the flanches connecting the tube sheet and crown of the furnaces to the sides, and in other respects injuring the engine; it was one of Winan's build, and had been running over four years, rendering the Company valuable service. The sides of the furnace were constructed half of copper and half of iron, the lower part copper, the upper iron. The copper lapping on the iron and stayed throughout with $\frac{3}{4}$-iron screw stay bolts, 4 inches apart. The fractures took place in the lap of the copper sheet through the rivet holes, running along the lap nearly in a straight line for 30 inches, and then taking a downward course for a distance of 15 ins.



at one end, and 12 inches at the other, turned down against the lower portion of the sheet as shown in Fig. 1.

The original thickness of the copper appears to have been $\frac{3}{8}$-ths of an inch, but was much worn and reduced in thickness, the fractured section presenting the appearance of a wedge with one side corrugated, quite thin at the lap, and retaining nearly its original thickness at the lower edge of the furnace. The fire surface of the damaged portion of the sheet could not be examined, having lapped over so as to prevent it, but the opposite (copper) side of the furnace presented the appearance of having been cut out irregularly

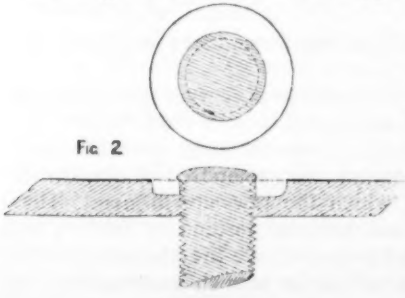


Fig 2

Half size.

with a gauge varying in depth from $\frac{1}{16}$th to $\frac{3}{16}$ths of an inch, no portion of the fire surface near the centre of the furnace being exempt from this effect of intensified heat. The stay bolts were perfect, not the slightest effect visible from galvanic action; rather having the appearance of being recently been put in.

A phenomena presents itself in the effect the fire has had on the copper around the stay bolts, for which a satisfactory explanation is wanting, viz: *around each stay bolt, a circular recess is cut in, from* $\frac{1}{8}$*th to* $\frac{3}{16}$*ths of an inch deep, and* $1\frac{1}{2}$ *inches in diameter, (or just twice the diameter of the bolts,) concentric with the bolts, having the appearance of being bored in with a centre drill, so near were they of a size in their diameters,* and cut close to the bolts, leaving nothing but the copper thread in the spiral groove of the stay bolt. Sketch No. 2 will give a general idea of this cutting process about the stay bolts.

The working pressure was 90 lbs., under ordinary circumstances.

C.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, October 16th, 1856.

John Agnew, Vice President, in the chair.

Isaac B. Garrigues, Recording Secretary.

The minutes of the last meeting were read and approved.

Donations to the Library were presented from the Commissioners of Patents; The Statistical Society; The Geological Society, and the Institute of Actuaries, London; The Regents of the University of the State of New York, and William J. McAlpine, Civ. Eng., Albany, New York; The Mercantile Library Association of the City of New York; The Massachusetts Charitable Mechanics' Association, Boston, Mass.; W. Milnor Roberts, Civ. Eng., Pittsburgh, Penna; Mrs. W. H. Keating and Messrs. J. H. Byram and Robert C. Cornelius of Philadelphia.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer read his statement of the receipts and payments for the month of September.

The Board of Managers and Standing Committees reported their minutes.

Candidates for membership in the Institute (22) were proposed, and the candidates proposed at the last meeting (17) were duly elected.

W. Jones exhibited a new style of set wrench whose general appearance is that of the ordinary **S** wrench, but composed of two distinct pieces or plates, upon the ends of which the jaws are formed. These plates lie together flat ways, and are held in position by feathers and grooves made in the thick parts that project above the plates to give the required depth to the jaws. Each half of the wrench has a feather and groove. Midway of the handle is a screw, secured in one plate from end motion by collars, and working in a nut attached to the reverse plate;

the axis of this screw is in the same plane as the junction of the plates, and at right angles to the interior sides of the jaws, and consequently, from the shape of the wrench standing at an angle with the handle. This position of screw causes the strains to approach those of tension and compression on the plates composing the handle, and correspondently lessens that of flexure. The appearance of the wrench is neat, and it looks more substantial than the ordinary screw or monkey wrench.

Also, an apparatus designed for crimping boot leather, consisting of a foot and leg piece hinged together near the instep, and provided with clamp screws for holding the leather on, and with a screw arranged to stretch it across the instep, by moving the hinged frame to which the clamp screws that hold the shank corners are attached; another screw causes the foot and leg piece to assume an angular position with each other, the operator rubbing down with his hand any creases that appear, and regulating the clamp screw frame to equalize the stretching of the leather over the toe, the instep, or the leg part. The instrument is composed entirely of metal, and is mounted on a swivelling stand that can be moved so as to present both sides to the operator. It is not necessary that the leather should dry while on the machine, but it can be taken off and hung up by means of a looped string to dry, thus leaving the machine free to be used for fresh pieces.

Several apple parers were shown, which after paring, cut the apple into pieces or slices, ready for immediate use or for drying.

Henry Howson exhibited David E. Paynter's mode of solidifying coal dust by mixing it with plaster of Paris so as to render it portable and serviceable as an article of fuel, the ashes of which may be used as manure. (Two specimens, one of the solidified coal dust, and the other of the ashes, was shown,) for which a caveat has been entered at the Patent Office.

Also a model (to a scale of 1½ inch to a foot,) of the shrouds and buckets of a water wheel designed by H. Howson and A. Monnier, for Mr. Penrose's paper mills at Carlisle, Penna. The wheel is 30 feet diameter and 8 feet broad, and is constructed entirely of wood, with the exception of a few stay bolts. The peculiarity of the wheel consists in the arrangement of the back of the buckets, so that a free ventilation is afforded and sole plate dispensed with; the arrangement is in some respects similar in principle to that of Fairburn's iron wheel.

An illustrated description of the above in detail will shortly appear in the *Journal* of the Institute.

Also, new tail piece for violins by C. M. Zimmerman (patent applied for). This invention consists in a ready mode of removing and replacing the tail piece, also in a plan of connecting the strings to the same, without tying them in knots, but simply by means of a single fold in connexion with a peculiarly shaped peg. In the tail piece is a circular recess in which the ends of the strings are coiled.

Also, an improvement in flutes by J. Pfaff, which consists in placing the mouth piece of the flute at right angles to the body of the same, so that the instrument may be played upon without the performer twisting his arms and neck into an unnatural position.

S. S. Garrigues exhibited and explained the use of *Mitscherlich's Ap-*